



AERONAUTICAL ENGINEERING

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WITH INDEXES
Supplement 57

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 57

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in April 1975 in:

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 306 reports, journal articles, and other documents originally announced in April 1975 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

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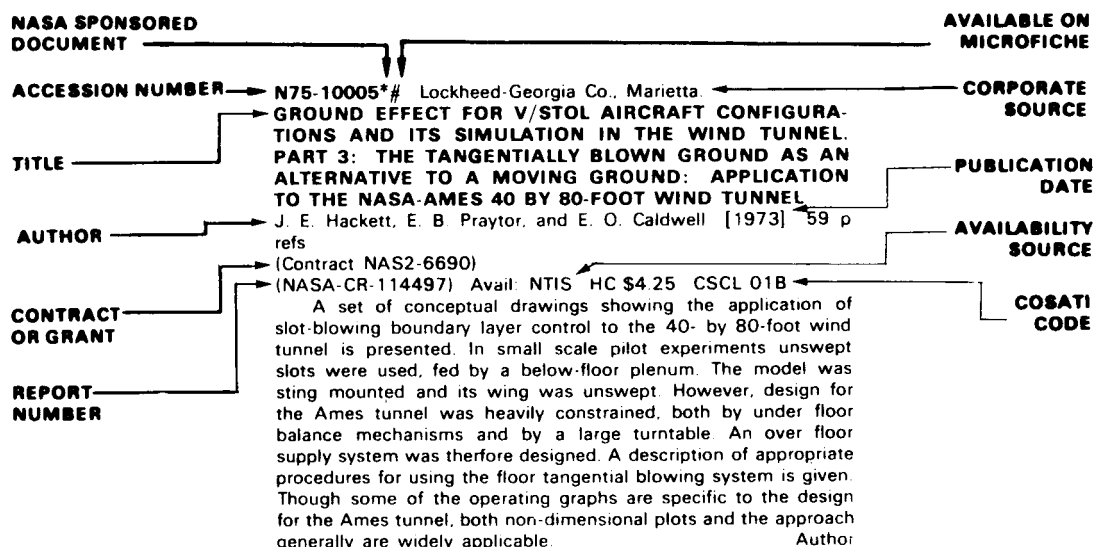
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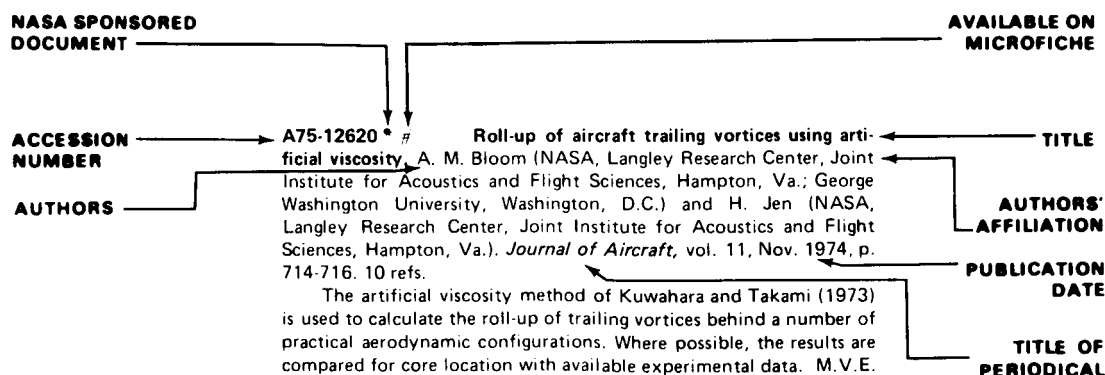
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AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 57)

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IAA ENTRIES

A75-19580 # Target acquisition in remotely piloted vehicles. J. Spintzyk and P. Starke. *Dornier-Post* (English Edition), no. 3-4, 1974, p. 28-31.

Results of RPV missions flown against previously reconnoitred targets are discussed in re visual detection range, angular resolution, image aperture, target acquisition and engagement, and control station. Visual detection range fell off with darkness or poor target contrast; targets were recognizable with angular resolutions of 0.2 to 0.3 mrad/line; the smallest possible horizontal image aperture was the most efficient; a combination image sensor system working in two spectral ranges was the most promising solution to the target acquisition and engagement problem; and the control station design featured RPV controlled by one man (the pilot). S.J.M.

A75-19585 # Commercial transports - Decade of derivatives. G. Sim and R. H. Hopps (Lockheed-California Co., Burbank, Calif.). *Astronautics and Aeronautics*, vol. 13, Feb. 1975, p. 24-32.

The high costs and risks involved in developing new commercial aircraft designs are discussed. A survey of the history of commercial air transports over the last thirty years shows that large and discontinuous advances in propulsion technology have led to new designs when they could not be applied to old designs on a cost-effective basis. Present economic and technological trends suggest that existing designs will have unusually great longevity, and improvements in the near future are more probable through derivatives than through all-new aircraft. A.T.S.

A75-19586 # Radio aids for aircraft landing, short-range navigation, and secondary radar systems. G. A. Pakholkov (All-Union Radio Research Institute for Scientific Work, USSR). *Astronautics and Aeronautics*, vol. 13, Feb. 1975, p. 36-43.

The air traffic control systems developed in the Soviet Union have been incompatible in many ways with systems used in other countries. The ways in which the widely used SP-50M landing beacon system differs from foreign ILS are summarized. Increasing foreign traffic to the USSR prompted the development of a composite airborne radio receiver type, the KURS-MP series, which operates in SP-50, ILS, and VOR modes. The characteristics of SP-50M, SP-68, and SP-70 landing beacons are summarized. Recommendations are made concerning the development of an international microwave aircraft landing system to supplant present meter-band systems. The characteristics of Soviet short-range navigation facilities and the secondary radar system are discussed, and future changes are suggested. A.T.S.

A75-19587 # New look for products liability in aviation. J. V. Brennan (United States Aviation Underwriters, Inc., New York, N.Y.). *Astronautics and Aeronautics*, vol. 13, Feb. 1975, p. 44-47.

Changing trends in the laws covering manufacturers' responsibility for accidents involving their products are discussed. Examples from aircraft and motor-vehicle cases are used to illustrate the transition from the theory of culpable negligence to the theory of strict liability in tort, which is now dominant. The importance of

providing adequate warnings of suspected product defects and ensuring the crashworthiness of aircraft is stressed. A.T.S.

A75-19648 # Calculation of the radiation pattern of an airborne antenna-radome combination (Calcul du diagramme d'un ensemble antenne-radôme aéroporté). M. Chabah (Thomson-CSF, Division Equipements Avioniques, Malakoff, Hauts-de-Seine, France). *Revue Technique Thomson - CSF*, vol. 6, Sept. 1974, p. 751-773. In French.

A computer program using approximations based on geometric optics to predict an antenna pattern is described and favorably compared in detail to experimental measurements. Verification of calculated perturbations due to reflections within the dome is especially satisfactory. The antenna is assumed to be a receiving antenna, which enables allowance to be made for the reflection of rays inside the radome. The organization of the computation is presented vis-a-vis geometric and radioelectric assumptions, determination of the integration zone, deformation of the field tubes, determination of the radome transmission and reflection coefficients, and integration on the antenna. S.J.M.

A75-19650 # Head-up piloting display (Dispositif de pilotage tête haute). G. de Sury (Thomson-CSF, Division Equipements Avioniques et Spatiaux, Issy-les-Moulineaux, Hauts-de-Seine, France). *Revue Technique Thomson - CSF*, vol. 6, Sept. 1974, p. 787-798. In French.

Following a summary of reasons for the need to present certain information in head-up fashion, two types of apparatus are described: (1) displays aiding piloting in good visibility (earth landmarks constituted by real exterior world, equipment simple); and (2) displays assuring automatic flight surveillance while providing for manual takeover (equipment more complex, since it must furnish a reconstituted image of the world, be it just a horizon or a horizon plus runway). The displays utilize semi-reflecting inclined retractable glass panels. S.J.M.

A75-19664 # The flow field in the environment of a planar plate in parallel flow within the range of free molecular flow (Das Strömungsfeld in der Umgebung einer längsangeströmten ebenen Platte im Bereich der freien Molekülströmung). H. Gasteiger and F. J. Hindelang (München, Technische Universität, Munich, West Germany). *Zeitschrift für angewandte Mathematik und Mechanik*, vol. 54, Dec. 1974, p. 767-771. 8 refs. In German.

The problem of supersonic free molecular flow near the leading edge of a flat plate is solved by assumption of the principle of sight. The integrals related with the calculation of the flow variables are determined by application of modified Bessel functions. This yields an analytical solution for the density and flow velocity. Numerical solutions are presented. (Author)

A75-19690 Control-display-stability-augmentation system. E. P. Rolek (Systems Research Laboratories, Inc., Dayton, Ohio). In: Human Factors Society, Annual Meeting, 18th, Huntsville, Ala., October 15-17, 1974. Santa Monica, Calif., Human Factors Society, 1974, p. 255-258. Contract No. F33615-72-C-1064.

Helicopters cannot currently use their unique capabilities under low or zero visibility conditions because they lack the necessary avionics. Rather than pursuing a fully automatic system, several systems (e.g., 3 axis flight director) were developed which were almost totally under manual control. This study used objective and subjective data to evaluate these systems under simulated zero visibility conditions for cruise and approach flight profiles. The data indicated that for almost all cases these systems increased performance and decreased workload when compared to using situation-only displays. (Author)

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A75-19803 Monopulse aerals for airborne radars. R. Graham, M. F. Doyle, and S. J. Alexander (Marconi-Elliott Avionic Systems, Ltd., Borehamwood, Herts., England). In: European Microwave Conference, 4th, Montreux, Switzerland, September 10-13, 1974, Proceedings. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1974, p. 362-366. Research supported by the Ministry of Defence (Procurement Executive).

The paper begins by summarizing the characteristics of a number of monopulse aerals applicable to airborne radar. For such a use, it is often important that the aerial has low sidelobes. Good sidelobe performance may be obtained with a flat plate array which can have an accurately controlled aperture distribution and is free from feeder blockage and spillover. The development of a novel flat plate sandwich wire array is described and some experimental results are presented. (Author)

A75-19824 A printed antenna/radome assembly /radant/ for airborne Doppler navigational radar. T. W. Bazire, A. W. D. Ludgate (Decca Radar, Ltd., Hersham, Surrey, England), and R. H. J. Cary (Royal Radar Establishment, Great Malvern, Worcs., England). In: European Microwave Conference, 4th, Montreux, Switzerland, September 10-13, 1974, Proceedings. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1974, p. 494-498. Research supported by the Ministry of Defence (Procurement Executive) and Decca Radar, Ltd.

Antennas for airborne Doppler navigational radars must produce at least three accurately defined beams. The design of such antennas is generally based on the use of slotted waveguides, although a cluster of accurately aligned dishes has also been employed. The associated radomes are always separate and are normally flush with the aircraft skin. Of the various types of antenna employed, the slotted waveguide planar array occupies the least volume. By realizing a planar array in printed circuit form and by integrating such an antenna with its radome to form a radant, it has been possible to minimize size, weight, and cost relative to those of the corresponding waveguide system with only a very small trade-off in accuracy of performance; furthermore, installation problems have been reduced and spurious responses due to radome vibration have effectively been eliminated. (Author)

A75-19870 Suppression of spatial waves by distortion of jet velocity profile. Y. Y. Chan and J. T. Templin (National Aeronautical Establishment, Ottawa, Canada). *Physics of Fluids*, vol. 17, Nov. 1974, p. 2124, 2125. 6 refs.

It is shown experimentally that the turbulent shear layer of a circular jet having a bell-shaped velocity profile cannot support a wave disturbance. The spatial growths of the axisymmetric pressure waves decay rapidly downstream from the nozzle exit for a wide range of forcing frequencies investigated. (Author)

A75-19908 # Some aspects of aerial combat. W. Y. Peng and T. L. Vincent (Arizona, University, Tucson, Ariz.). *AIAA Journal*, vol. 13, Jan. 1975, p. 7-11. 10 refs.

A 'dogfight' between two aircraft each represented by a point mass in a horizontal plane of constant speed with bounded turning capability is examined. A number of complexities associated with

this problem are avoided by the way the capture zones for each of the players are defined. However, by so doing, the possible outcomes of mutual destruction and draw are not distinguishable from a win by each of the players. Both the methods of Qualitative Game Theory and Control Theory are used in the analysis of a particular example. Two regions of state space of interest to the first aircraft are delineated. These regions have the property that if the second aircraft is located in the first region, the first aircraft can win the dogfight; however, if the second aircraft is located in the second region, then the first aircraft may lose the dogfight. (Author)

A75-19909 # Improved gradient algorithm for two-point boundary value problems. H. G. Moyer (Grumman Aerospace Corp., Bethpage, N.Y.). *AIAA Journal*, vol. 13, Jan. 1975, p. 17-19. 9 refs.

Although variable final point problems can be readily solved by the gradient procedure, the two-point case is troublesome. In the present paper the original two-point boundary value problem is replaced by one with a variable endpoint. The minimum of the cost functional of the original formulation appears in the new problem as a free parameter. The two problems have identical solution extremals provided the parameter is given its correct value. The new problem is solved initially using an estimate for the parameter and a first order correction is then calculated. This process is repeated until all the boundary values lie within their tolerances. The efficacy of the method is shown by its application to three-dimensional aircraft trajectory optimization. (Author)

A75-19911 # Hypersonic ionizing air viscous shock-layer flows over sphere cones. E. W. Miner and C. H. Lewis (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *AIAA Journal*, vol. 13, Jan. 1975, p. 80-88. 25 refs.

In the investigation reported, the viscous shock-layer equations which follow the formulations of Davis (1970) are solved for flows over sphere-cones. The method considered can be used in the case of nonequilibrium, multi-component, ionizing air and for dissociating oxygen. The results obtained are compared with predictions of other finite-difference methods and with experimental data. The comparisons show that the present method predicts with reasonable accuracy mean flowfield quantities such as temperature profiles, surface heat-transfer distributions, and electron concentration profiles. G.R.

A75-19914 # Influence of subsonic potential flow on the buckling of thin panels under edge compression. A. Kornecki (Technion - Israel Institute of Technology, Haifa, Israel). *AIAA Journal*, vol. 13, Jan. 1975, p. 106, 107. 6 refs.

An investigation is conducted of the static stability of a thin elastic panel of infinite width which is simply supported along its edges and loaded by uniformly distributed compressive forces. In the investigation a small lateral deflection is imposed. The deflection changes the dynamic pressure of the ambient flow. It is pointed out that the expression obtained in the study is also valid for a thin symmetrical airfoil in noncirculatory flow. G.R.

A75-19918 * # Strong interaction associated with transonic flow past boattailed afterbodies. W. L. Chow (Illinois, University, Urbana, Ill.), L. J. Bober, and B. H. Anderson (NASA, Lewis Research Center, Cleveland, Ohio). *AIAA Journal*, vol. 13, Jan. 1975, p. 112, 113. 8 refs. Grant No. NGL-14-005-140.

The problem of transonic flow past boattails was studied with the aid of numerical relaxative schemes. Preliminary calculations were restricted to a particular model configuration which had been tested in an experimental program. It was found that the full potential equation must be considered in the study. The final results agreed very well with the experimental data. The investigation illustrates the strong interaction character of the transonic flow past a boattailed afterbody. G.R.

A75-19922 # Comment on 'Hypersonic ionizing air viscous shock-layer flows over sphere cones'. S.-W. Kang and M. G. Dunn (Calspan Corp., Buffalo, N.Y.). *AIAA Journal*, vol. 13, Jan. 1975, p. 118-121; Authors' Reply, p. 121-125. 32 refs.

A75-19956 Theoretical investigation of flow in a nozzle with a two-phase working body. I. A. Lepeshinskii (Moskovskii Aviatsionnyi Institut, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 12, May-June 1974, p. 578-584.) *High Temperature*, vol. 12, no. 3, Jan. 1975, p. 497-502. 6 refs. Translation.

Analysis of the efficiency of two-phase media for thermal-to-kinetic energy conversion in jet engines, heat exchangers and magnetohydrodynamic systems. A two-velocity two-temperature flow model with phase transitions was developed for studying the performance of two-phase fluids in a quasi-one-dimensional approximation. The model was applied to a study of the effect of the nozzle geometry and boundary conditions on the efficiency of a nozzle operated with a liquid/vaporized potassium flow as the two-phase working medium. V.Z.

A75-20033 # A Laval nozzle design which realizes the zero-moment state (Proekt sopla Lavalia, realizuiushchii bezmomentnoe sostoianie). V. D. Koshur and Iu. V. Nemirovskii (Akademiia Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR). *Problemy Prochnosti*, Dec. 1974, p. 66-72. 5 refs. In Russian.

Derivation of the reinforcement law and the thickness variation function which realize the zero-moment state in a reinforced Laval nozzle type shell of revolution. A study is made of an axisymmetric Laval nozzle type shell subjected to the action of a temperature field which varies along the meridian of the shell and is constant along the shell thickness and, in addition, is subjected to the action of a pressure arising as a result of the discharge of an ideal adiabatic gas through the nozzle. The shell thickness variation function is determined, as well as the law of reinforcement of the shell by a pair of one-dimensional fibers asymmetrically arranged with respect to the meridian, and the nozzle temperature regime in order to ensure the realization of a zero-moment state of nozzle operation. With knowledge of all these parameters uniformity of operation of each cross section of the shell and the absence of bending stresses can be achieved. A.B.K.

A75-20035 # Calculation of profiled three-layer blades of centrifugal fans (Raschet profilirovannykh trekhslonnykh lopatok tsentrobraznykh ventilatorov). V. T. Gorlyshkin and I. F. Mariichuk (Institut Gornoi Mekhaniki i Tekhnicheskoi Kibernetiki, Donetsk, Ukrainian SSR). *Problemy Prochnosti*, Dec. 1974, p. 77-80. In Russian.

Development of a variational method of calculating profiled blades having the form of shallow open three-layer cylindrical shells of variable thickness with rigid and light fillers. A calculation is made of the most general case of a blade with a rigid orthotropic filler, from which formulas are obtained for blades with an orthotropic filler and zero rigidity in one of the directions and for blades with an isotropic light filler of foam-plastic type. An algorithm and a computer program for solving the resulting system of algebraic equations are described. The results of a calculation of the stressed state of a profiled blade with both types of fillers are presented as an example. A.B.K.

A75-20077 # The problem of supersonic flow past a slender pointed body with a tail unit (K zadache ob obtakanii sverkhzvukovym potokom tonkogo zaostrennogo tela s khvostovym openiem). E. M. Surkova (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriya I - Matematika, Mekhanika*, vol. 29, Nov.-Dec. 1974, p. 66-73. 7 refs. In Russian.

Consideration of the interactions occurring between the various parts of a slender pointed body of revolution with a tail unit moving in a supersonic flow. Volterra's method is applied to the solution of the problem of the interference between the pointed head and the

cylindrical hull of a body moving at a supersonic speed. Integral equations for determining the potential of the interaction between the hull and the tail unit are obtained, and methods of solving these equations are indicated. A.B.K.

A75-20119 * Investigation of the aerodynamic noise generating region of a jet engine by means of the simple source fluid dilatation model. P. M. Hurdle, W. C. Meecham (California, University, Los Angeles, Calif.), and B. K. Hodder (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *Acoustical Society of America, Journal*, vol. 56, Dec. 1974, p. 1708-1721. 18 refs. NASA-supported research.

An experiment was conducted on a full-scale jet engine to investigate the aerodynamic noise generating regions in the free jet. Cross-correlation measurements were made between the static pressure fluctuations and the farfield radiated sound. These measurements were made for two different static pressure probe positions and a large number of farfield positions (at various angles). In addition, each test geometry was run for four different jet exit velocities. The measured, normalized cross-correlation functions varied between 0.004 and 0.155. A new Q-function, based on the above normalized cross correlation is defined and plotted. This function represents the source strength per unit volume within the jet region. This Q-function shows dependence on the probe position, the angular position of the farfield microphone, and the jet exit Mach number. Third-octave analyses of both the probe signal and the farfield radiated sound were made. The results show that cross-correlation techniques are a valuable tool in the investigation of the aerodynamic noise generating regions of an actual jet engine.

(Author)

A75-20252 * Numerical solutions of supersonic and hypersonic laminar flows over a two-dimensional compression corner. C. M. Hung and R. W. MacCormack (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-2*. 11 p. 16 refs.

An efficient time-splitting, second-order accurate, numerical scheme is used to solve the complete Navier-Stokes equations for supersonic and hypersonic laminar flow over a two-dimensional compression corner. A fine, exponentially stretched mesh spacing is used in the region near the wall for resolving the viscous layer. Good agreement is obtained between the present computed results and experimental measurement for a Mach number of 14.1, a Reynolds number of 104,000, and wedge angles of 15, 18, and 24 deg. The details of the pressure variation across the boundary layer are given, and a correlation between the leading edge shock and the peaks in surface pressure and heat transfer is observed. (Author)

A75-20253 # An interaction model for the solution of laminar separation on a surface. G. Miller and A. Fanchiotti (New York University, New York, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-5*. 26 p. 26 refs. Contract No. N0014-67-A-0467-0021.

An analytical model and computer program has been developed to analyze supersonic, laminar separating flow fields over ramps. The important features of the model are its ability to include the two family nature of the supersonic flow field, the matching of supersonic and subsonic profiles in the transonic region (which aids in the selection of the solution for a particular problem when two exist, thus eliminating the problem of branching solutions), the inclusion of the normal momentum equation (and thus normal pressure gradients) throughout the flow field, and the solution of the separation problem by a marching technique. The ellipticity of separated flow fields is accounted for by casting the problem into one of inverse nature. Correlations with data are utilized to determine upstream influence properties. Results for pressure distribution and heat transfer are presented and compared with experimental data. (Author)

A75-20257 * # Quantitative density visualization in a transonic rotor. A. H. Epstein (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-24.* 18 p. Grant No. NGL-22-009-383.

The flow in a two foot diameter transonic rotor has been visualized using a fluorescent gas, 2, 3 butanedione, as a tracer. The technique allows the three dimensional flow to be imaged as a set of distinct planes. Quantitative static density maps can be obtained after correcting the images for distortion and nonlinearities introduced by the illumination and imaging systems. The visualized flow is compared to data taken simultaneously by high frequency pressure transducers near the rotor entrance and exit planes. (Author)

A75-20258 # Dynamic stall analysis in light of recent numerical and experimental results. L. E. Ericsson and J. P. Reding (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-26.* 20 p. 58 refs.

An earlier developed engineering analysis of dynamic stall is reviewed in light of recent numerical and experimental results. It is found that the concept of equivalence between boundary layer improvement due to pitch-rate-induced effects and increasing Reynolds number is supported by the available numerical and experimental results. The existence of the postulated plunging-induced improvement of the boundary layer and associated delay of stall, the controversial 'leading edge jet' effect, is indicated by oscillatory stall data for different oscillation centers and by the measured negative aerodynamic damping for plunging oscillations in the stall region. The present technique offers a reliable means for prediction of low-frequency dynamic stall characteristics from static experimental data. (Author)

A75-20261 * # Advanced panel-type influence coefficient methods applied to subsonic flows. F. T. Johnson and P. E. Rubbert (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-50.* 11 p. 13 refs. Contracts No. NAS2-7729; No. NAS1-12185.

An advanced technique for solving the linear integral equations of three-dimensional subsonic potential flows (steady, inviscid, irrotational and incompressible) about arbitrary configurations is presented. It involves assembling select, logically consistent networks whose construction comprises four tasks, which are described in detail: surface geometry definition; singularity strength definition; control point and boundary condition specification; and calculation of induced potential or velocity. The technique is applied to seven wing examples approached by four network types: source/analysis, doublet/analysis, source/design, and doublet/design. The results demonstrate the forgiveness of the model to irregular paneling and the practicality of combined analysis/design boundary conditions. The appearance of doublet strength mismatch is a valuable indicator of locally inadequate paneling. S.J.M.

A75-20262 * # Convergence acceleration and shock fitting for transonic aerodynamics computations. M. M. Hafez and H. K. Cheng (Southern California, University, Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-51.* 23 p. 55 refs. NASA-supported research; Contract No. N00014-67-A-0269-0021.

Two problems in computational fluid dynamics are studied in the context of transonic small-disturbance theory - namely, (1) how to speed up the convergence for currently available iterative procedures, and (2) how a shock-fitting method may be adapted to existing relaxation procedures with minimal alterations in computer programming and storage requirements. The paper contributes to a

clarification of error analyses for sequence transformations based on the power method (including also the nonlinear transforms of Aitken, Shanks, and Wilkinson), and to developing a cyclic iterative procedure applying the transformations. Examples testing the procedure for a model Dirichlet problem and for a transonic airfoil problem show that savings in computer time by a factor of three to five are generally possible, depending on accuracy requirements and the particular iterative procedure used. (Author)

A75-20264 * # Design and testing of new center inlet and S-duct for B-727 airplane with refanned JT8D engines. C. T. Ting, G. Kaldschmidt, and B. E. Syltebo (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-59.* 10 p. Contracts No. NAS3-16815; No. NAS3-17842.

The work described in this paper was part of the NASA refan program. The airflow requirement of the refanned JT8D (-100 series) engine increased about 50% above that of the basic JT8D. This required a redesign of the center inlet and S-duct of the Boeing 727 airplane. The paper describes the design constraints for the S-duct and the analytic method used to define the lines of the new duct. Model tests that were conducted at static, angle-of-attack, and crosswind conditions are described with a variety of flow control devices. Test results showed that the new inlet and S-duct have a pressure recovery comparable to that of the existing inlet. By employing corotating vortex generators, less flow distortion was obtained for the core region than the existing duct has with its counter rotating vortex generators. (Author)

A75-20265 # Analysis of unsteady transonic channel flow with shock waves. G. K. Richey (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and T. C. Adamson, Jr. (Michigan, University, Ann Arbor, Mich.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-61.* 14 p. 10 refs. Contract No. N00014-67-A-0226-0005. Project SQUID.

The inviscid, unsteady flow in a two-dimensional channel with a sonic throat is analyzed using an asymptotic expansion for the velocity potential in terms of a small parameter which is a measure of the nondimensional perturbation velocity. The analysis includes the case where shock waves exist in a channel with arbitrary wall shape, with arbitrary disturbances imposed at a given downstream location. Solutions for the first- and second-order perturbation potentials are derived. These outer solutions are not uniformly valid near the shock, since they do not satisfy shock jump conditions of second and higher order, requiring the existence of an inner region with solutions which are matched asymptotically to those in the outer region. Numerical results for the flowfield in an accelerating nozzle flow with a shock wave, where the nozzle back pressure is oscillating sinusoidally, show the resulting shock wave motion and unsteady flow downstream of the shock wave. (Author)

A75-20266 # The numerical computation of the transonic flow over afterbodies including the effect of jet-plume and viscous interactions. B. Grossman and R. E. Melnik (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-62.* 13 p. 22 refs.

A numerical procedure has been developed to compute the complete flow field in the vicinity of the aft-end of a vehicle traveling at transonic speeds. The inviscid flow external to the afterbody and plume is computed with a mixed-flow relaxation procedure; the supersonic flow within the exhaust stream is calculated by a hyperbolic 'marching' technique; and the boundary layer and mixing region are computed using a turbulent kinetic energy approach. A strong interactive coupling exists between these various regions, and the flow fields are solved in a simultaneous, iterative fashion. Results for the computed flow structure and surface conditions are presented illustrating the complicated nature of afterbody flows. (Author)

A75-20267 * # Internal cowl-separation at high incidence angles. A. K. Jakubowski (Virginia Polytechnic Institute and State University, Blacksburg, Va.) and R. W. Luidens (NASA, Lewis Research Center, V/STOI and Noise Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-64.* 15 p. 10 refs.

Internal flow separation at large incidence angles is studied on the basis of wind-tunnel pressure data for six axisymmetric inlet geometries. The inlet geometric variables investigated are the angle of incidence, the throat Mach number, the internal lip contraction ratio, 'sharpness' of the external shape, and freestream velocity. It is shown that an increase in lip contraction ratio delays internal flow separation, while an increase in the sharpness of the external profile tends to reduce the angle of incidence at which complete flow separation occurs. It is also shown that inlet flow separation is subject to scale effects associated with the boundary layer on the cowl surface. The scale effects are particularly pronounced at very high throat Mach numbers. V.P.

A75-20268 * # Wind-tunnel investigation of surface-pressure fluctuations associated with aircraft buffet. D. W. Riddle (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-67.* 20 p. 22 refs.

Fluctuating pressures and forces that cause aircraft buffeting have been measured on a semispan rigid-wing model of a typical variable-sweep fighter-type aircraft at transonic speeds. The rms spectral and spatial correlation characteristics of wing fluctuating pressures, fluctuating pressure summations, and structural responses are presented and discussed for a Mach number of 0.85, wing sweep angles of 26 and 72 deg, and angles of attack up to 12 deg. The fluctuating pressure characteristics beneath wing shock waves and leading-edge vortices and in regions of attached and separated flows are presented. Results indicate that: (1) the mean and fluctuating static pressure characteristics are related; (2) a circulation oscillation exists for attached flow conditions below buffet onset; and (3) a significant coupling exists between the wing shock-wave oscillation and the wing first torsional mode when shock-induced separation is present. (Author)

A75-20269 * # Update on an investigation of flight buffeting of a variable-sweep aircraft. D. B. Benepe, A. M. Cunningham, Jr., S. Traylor, Jr., and W. D. Dunmyer (General Dynamics Corp., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-68.* 12 p. 5 refs. Contract No. NAS2-7091.

A detailed investigation of flight buffeting response of an F-111A aircraft was performed. AIAA Paper No. 74-358 presented results of an initial study of wing and fuselage responses measured at subsonic speeds and wing leading-edge sweep of 26 degrees. The present paper gives additional results for wing sweeps of 26, 50 and 72.5 degrees at Mach numbers up to 1.2 including horizontal tail responses. Power spectra, response time histories, variations of rms response with angle of attack, and effects of Mach number and wing sweep angle are discussed. (Author)

A75-20270 * # Airloads near the open port of a one-meter airborne telescope. D. A. Buell (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-71.* 11 p. 6 refs.

An infrared telescope is mounted in a cavity in the fuselage of a C-141 airplane. The cavity is sealed off from the rest of the fuselage and can be opened to the outside for viewing. A retractable porous spoiler is installed ahead of the opening to inhibit cavity resonance. The paper presents the mean pressures, pressure fluctuations, spectra,

phase, and coherence of the pressures in the cavity and on the fuselage near the cavity, along with pertinent acceleration and torque information for the aircraft structure and telescope. It is shown that a moderate spoiler extension controls resonance in normal flight attitudes and produces a cavity environment with approximately the same turbulence intensity as an attached turbulent boundary layer. (Author)

A75-20275 * # The use of local basis functions in unsteady aerodynamics. J. Fromme (Boeing Commercial Airplane Co., Seattle, Wash.) and D. Halstead (Boeing Computer Services, Inc., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-100.* 7 p. 19 refs. Contract No. NAS2-7729.

This paper reports a successful demonstration of using local basis functions to solve Kussner's integral equation for unsteady airloads. Pressure basis functions are defined over relatively small subsets of the aerodynamic surface and are zero elsewhere. This formulation combines the accuracy and smoothness of distribution methods with the simplicity and versatility of panel methods. Application is made to subsonic compressible flow about oscillating planar surfaces with controls. Numerical results are presented. Convergence with respect to panel size, extensions to more general classes of solutions, and areas needing additional investigation are discussed. (Author)

A75-20278 * # Dynamic stall experiments on oscillating airfoils. W. J. McCroskey, L. W. Carr, and K. W. McAlister (U.S. Army, Air Mobility Research and Development Laboratory; NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-125.* 14 p. 25 refs.

Dynamic stall and unsteady boundary layer separation have been studied in incompressible flow at moderately large Reynolds numbers. By varying the leading-edge geometry of an NACA 0012 airfoil, three different types of stall were produced. For most of the configurations studied, including the basic NACA 0012 profile, dynamic stall was found not to originate with the bursting of a leading-edge laminar separation bubble, as is commonly believed. Instead, the vortex shedding phenomenon, which is the predominant feature of dynamic stall, appears to be fed its vorticity by the breakdown of the turbulent boundary layer. (Author)

A75-20280 * # Calculation of the flow on a blunted cone at high angle of attack. S. C. Lubard (R & D Associates, Santa Monica, Calif.) and J. V. Rakich (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-149.* 10 p. 17 refs. Contract No. NAS2-8113.

A new technique for calculating the entire flow-field on spherically blunted circular cones at high angles of attack and high Reynolds numbers is described. The calculations are based on a single-layer system of three-dimensional parabolic equations which are approximations to the full steady Navier-Stokes equations. Initial conditions at the sphere-cone tangency plane are provided by using an inviscid time-dependent solution added to a viscous nonsimilar boundary layer solution. Calculated results are compared with experimental heat transfer and pressure data for a 15 deg half-angle cone with a 1-in. spherical nose at 15 deg angle of attack. The free-stream Mach number is 10.6, and the free-stream Reynolds number is 1,200,000 per foot. Excellent agreement between the calculated and experimental data for both pressure and heat transfer is obtained. (Author)

A75-20284 # Flow characteristics about concave conic forebodies at high Mach number. M. J. Abbett, L. Cooper, T. J. Dahm, and M. D. Jackson (Acurex Corp., Mountain View, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-153.* 28 p. 16 refs.

A combined experimental and analytical program was conducted to study the effects of unsteady flows which may develop about concave conic shapes on ablating nose tips. A series of more than 40 tests was conducted at a free-stream Mach number of 5 with photographic, pressure, and vibration instrumentation to study the nature of such flowfields. The effects of geometry, Reynolds number, and angle of attack were studied. A metastable type flow not previously observed by others is discussed. The results were correlated in the form of a stability diagram. The analysis is based upon a steady-flow separation model which is used in an attempt to predict the limits of steady-flow behavior. (Author)

A75-20285 * # Numerical calculation of unsteady transonic potential flow over helicopter rotor blades. F. X. Caradonna (NASA, Ames Research Center; U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.) and M. P. Isom (New York, Polytechnic Institute, Brooklyn, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-168*. 8 p.

The small-disturbance potential equation appropriate to a helicopter in forward flight is derived. This equation is then solved for the flow over a nonlifting transonic rotor blade, using a completely implicit scheme that is an extension of the Murman-Cole mixed-difference technique. The flow in the tip region is most unsteady in the decelerating flow region, after the blade passes the $\psi = 90$ deg azimuthal station. The unsteadiness appears to be caused by expansion and compression waves that move slowly upstream of the blade as the relative incident flow decelerates. The influence of aspect ratio, advance ratio, and Mach number on this process is discussed. (Author)

A75-20286 * # Experimental determination of post-stall rotary derivatives for airplane-like configurations at several Reynolds numbers. M. H. Clarkson (Florida, University, Gainesville, Fla.), G. N. Malcolm, and G. T. Chapman (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 13th, Pasadena, Calif., Jan. 20-22, 1975, Paper 75-171*. 8 p. 7 refs.

Military and civilian airplane losses due to out-of-control spin motions are significant. Knowledge of rotary coefficients is necessary to understand the cause of spin entry and to devise proper recovery techniques. An exploratory wind-tunnel investigation has been conducted on simple airplane-like configurations on a rotary sting apparatus at rotation rates up to 10 rps. Rotary coefficients have been measured at unit Reynolds numbers from 2,000,000 to 24,600,000 per m and at angles of attack from 45 to 90 deg. Results show that the aerodynamic characteristics at steady spin rates are highly dependent on both spin rate and Reynolds number. (Author)

A75-20312 Sound generation by sources moving rectilinearly with variable acceleration. G. I. Grigor'ev, V. P. Dokuchaev, and V. Ia. Eidman (Nauchno-Issledovatel'skii Radiofizicheskii Institut, Gorki, USSR). (*Akusticheskii Zhurnal*, vol. 20, July-Aug. 1974, p. 537-542.) *Soviet Physics - Acoustics*, vol. 20, Jan.-Feb. 1975, p. 325-327. 11 refs. Translation.

A75-20336 Fatigue life prediction of aircraft structures - Past, present and future. W. Schütz (Industrieanlagen-Betriebsgesellschaft, Ottobrunn, West Germany). *Engineering Fracture Mechanics*, vol. 6, Dec. 1974, p. 745-773. 84 refs.

Hitherto existing methods for life calculation in the design state, for component testing, and for the full scale fatigue test are analyzed with respect to modern techniques. This task is undertaken in terms of the aircraft development phases: design, construction and development, prototype, and production and service, with emphasis on the first category. Under design are covered materials selection, determination of fatigue allowables, residual static strength and crack

propagation, design philosophy, and load spectrum. Each phase is discussed vis-a-vis present status, refinements immediately possible, potential improvements, and future research and investigations necessary. By bringing together modern, but readily available test and calculation procedures, major improvements in the accuracy of fatigue life predictions will result. S.J.M.

A75-20350 Pratt & Whitney F100 - Power for the Eagle and YF-16. D. Godfrey. *Flight International*, vol. 107, Jan. 23, 1975, p. 101-105.

In response to an RFP issued in April 1968 Pratt & Whitney proposed to develop two engines from a single gas generator. The two engines were designated F100-PW-100 for the Air Force and F401-PW-400 for the Navy. The engines were intended for the Air Force fighter, the F15 Eagle, and the Navy fighter, the F-14B Tomcat. Problems of engine development are discussed, giving attention also to afterburner modification and questions of materials technology. G.R.

A75-20363 # Balancing of a flexible rotor. IV - Some experiments on a seven-disk flexible rotor/bearing system. S. Miwa, T. Nakai (Aoyama-Gakuin University, Tokyo, Japan), I. Mimura (Fuji Electric Co., Ltd., Kawasaki, Japan), and Y. Minami. *JSME, Bulletin*, vol. 17, Dec. 1974, p. 1527-1537. 6 refs.

The conditional equation of balance of a flexible rotor and the possibility of a new balancing procedure by aid of a mode separation network have previously been proposed by one of the authors. This paper deals with some experiments to verify the theory, where a variety of unbalance distributions is artificially given to a seven-disk flexible rotor which is supported by two flexible bearings and is balanced based on our theory. The bearing vibration together with dynamic shaft deflection after balancing is minimized over a wide range of rotational speeds as high as its third critical speed. Thus the theory is experimentally proved to be valid for balancing a flexible rotor. (Author)

A75-20364 # On the vibration of a rotating shaft system having two rotors. S. Aiba (Yamanashi University, Kofu, Japan). *JSME, Bulletin*, vol. 17, Dec. 1974, p. 1538-1546. 7 refs.

In this paper, the vibration and the critical speed of a rotating shaft having two rotors are treated theoretically considering the gyroscopic effect of the rotors and the distributed mass of the shaft. A symmetrical shaft system in which both rotors are symmetrical and an asymmetrical one in which rotors and the bending rigidity of the shaft are asymmetrical are treated using different coordinate systems respectively, and the eigen-frequencies at any shaft speed and the critical speeds are calculated exactly. An approximate formula for the lowest critical speed of a symmetrical rotating shaft system having n rotors by Rayleigh's method and one for critical speeds of higher order by Ritz's method are obtained considering the gyroscopic effect of the rotors, and numerical examples are shown. (Author)

A75-20380 # Hypersonic flow of a viscous, radiating gas around blunt bodies (Obtekanie zatuplennykh tel giperzvukovym potokom viazkogo izluchaiushchego gaza). A. M. Rumynskii and V. P. Churkin. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol. 14, Nov.-Dec. 1974, p. 1553-1570. 25 refs. In Russian.

The method for computing the supersonic flow of an ideal gas around blunt bodies with detached shock wave proposed by Telenin et al. (1964) is extended to the case of the flow of a radiating gas around permeable surfaces. Approximation formulas are proposed, allowing the determination of heat flows in the neighborhood of the critical point directly from the parameters of the incoming flow. The effect of intense blowing of the radiating gas into the shock layer on heat exchange is analyzed. P.T.H.

A75-20382 # An approach to computing selective radiation (Ob odnom podkhode k raschetu selektivnogo izlucheniia). V. M.

Krivtsov. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol. 14, Nov.-Dec. 1974, p. 1595-1600. 6 refs. In Russian.

An approximate method for calculating selective radiation is proposed, based on the possibility of representing the absorption coefficient in the form of a sum of the derivatives of functions depending only on the frequency and of functions of the spatial coordinates. In this case, preliminary treatment of the data makes it possible to simplify significantly the calculation of the frequency-integrated density of radiation intensity. P.T.H.

A75-20383 # Detached shock wave before a wedge or cone (Otoshedshaya udarnaya volna pered klinom ili konusom). P. I. Chushkin. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol. 14, Nov.-Dec. 1974, p. 1600-1605. 6 refs. In Russian.

Numerical investigation of the supersonic flow around a wedge or cone with aperture angle greater than the critical angle when a detached shock wave forms in front of the body. The solution is obtained by the method of integral relations in special variables for a wide class of convex and concave bodies and various Mach numbers. The flow behavior is studied in particular for the case when the aperture angle approaches the critical angle. P.T.H.

A75-20413 # The supersonic flow around a sharp-nose elliptic cone at the angle of attack. V. N. Vetlutskiy and V. L. Ganimedov (Akademiya Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Archiwum Mechaniki Stosowanej*, vol. 26, no. 4, 1974, p. 647-652. 7 refs.

Numerical solution of complete gasdynamic equations was used to analyze the supersonic flow around an elliptic cone in a wide range of angles of attack when the stream between the body and the shock wave remains conic. The flow patterns at large and small angles of attack are shown to be considerably different. The calculated pressure coefficients agree well with experimental data in the literature. A.T.S.

A75-20415 # Natural oscillations of subsonic gas flow near a cascade and a biplane. V. B. Kurzin (Akademiya Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR). *Archiwum Mechaniki Stosowanej*, vol. 26, no. 4, 1974, p. 735-739.

A75-20418 # A new calculation of the wake of a flat plate. A. E. P. Veldman (Groningen, Rijksuniversiteit, Groningen, Netherlands). *Journal of Engineering Mathematics*, vol. 9, Jan. 1975, p. 65-70. 13 refs.

A new method is presented for the calculation of the wake of a finite flat plate. The method is based upon the recent investigations of the boundary layer near the trailing edge, which led to the triple-deck structure. This multilayered structure has now been extended to the 'classical' wake, which in fact is the continuation of the lowest two layers of the triple-deck. With this new numerical formulation an accuracy of .001% can easily be achieved. (Author)

A75-20432 # Numerical smoothing and filtering in applied aerodynamics (Lissage et filtrage numériques en aérodynamique appliquée). C. Ferrand (ONERA, Modane, Savoie, France). *La Recherche Aéronautique*, Nov.-Dec. 1974, p. 339-346. 9 refs. In French.

After a brief survey of various cases of smoothing and filtering in wind tunnel tests, two particular cases emphasizing the main difficulties encountered are examined. The first concerns the filtering of a stagnation pressure signal behind a leading-edge slat. The problem is to determine a filtering process that respects the phenomenon singularity (sudden pressure drop in the slat wake) while eliminating the noise. Convolution type and Kalman type filters are successively tried. The results show the impossibility of solving this problem without a particular treatment in the neighbourhood of the singularity. The second consists of determining the shape of the impulse imparted to a model, by means of the model supporting balance signal, as measured behind an analogical filter. Knowing the characteristics of the mechanical assembly and of the filter, the convolution process provides a satisfactory solution. (Author)

A75-20441 # A quasi-similarity analysis of the turbulent boundary layer on a flat plate. J. Mei and W. Squire (West Virginia University, Morgantown, W. Va.). *Applied Scientific Research*, vol. 29, Oct. 1974, p. 461-473. 13 refs. Contract No. N00014-68-A-0512.

The partial differential equation of the boundary layer on a flat plate are simplified by using the universal variables for turbulent flow. For laminar flow this gives boundary layer having a finite thickness and a friction coefficient differing by a few percent from the Blasius value. For a turbulent flow a differential equation for the velocity distribution is obtained with a parameter which varies slowly with the streamwise coordinate. The numerical value of this parameter is determined as an eigenvalue of the differential equations giving a velocity profile which evolves as the boundary layer thickens. Numerical calculations using a simple eddy viscosity model gave results in very good agreement with experiment. (Author)

A75-20449 # Type IV class 1 & 2 commercial airplane hydraulic fluids. W. G. Nelson and A. W. Waterman (Boeing Commercial Airplane Co., Seattle, Wash.). *Sperry Rand Corp., Aerospace Fluid Power Conference, 23rd, Troy, Mich., Nov. 18, 19, 1974, Paper. 52 p.*

During 1973-1974 Boeing has worked with the three suppliers of aircraft phosphate ester hydraulic fluids to develop and qualify Type IV low-density fluids in specific response to erosion resistance in the presence of chemical contaminants. Two such fluids have been approved for airline use. These fluids have been shown to tolerate 1000 ppm of an in-service chemical contaminant, arrest erosion when used as a 50/50 mixture with a contaminated fluid, and provide improved thermal stability by passing more stringent specification test requirements. Future developments are progressing on schedule for the development and qualification of high-density candidate fluids in response to customer interest. The objective of improving valve hardware for tolerance to erosion is being addressed by conducting evaluations of advanced port configurations. (Author)

A75-20450 # B-1 hydraulic power systems. V. J. Austin (Sperry Rand Corp., Troy, Mich.). *Sperry Rand Corp., Aerospace Fluid Power Conference, 23rd, Troy, Mich., Nov. 18, 19, 1974, Paper. 16 p.*

The hydraulic power systems of the B-1 are described. Minimum weight was the driving element in the requirement area. There are four independent, simultaneously operating power systems, each at 4000 PSIG. Power distribution and utilization, system cleanliness, an indication system monitoring 36 parameters, and three simulators in use for system development and qualification tests are also discussed. The article contains diagrams of pump arrangement, lines and fittings, intermittent duty utility actuators, continuous duty flight control actuator, primary and secondary flight controls, utility functions, and reservoir assembly and associated parts. S.J.M.

A75-20460 # Modeling of combustor swirl flows. D. G. Lilley (Cranfield Institute of Technology, Cranfield, Beds., England). *Acta Astronautica*, vol. 1, Sept.-Oct. 1974, p. 1129-1147. 30 refs.

Swirl is used extensively in gas turbine combustors, principally as a means of controlling flame size, shape, stability and combustion intensity. Rapid progress has been made in recent years in the development of mathematical models of combustor swirl flows which simulate the processes of turbulence, combustion, fuel droplet sprays, radiation and pollutant formation, and solve the resulting equations via a computational procedure, which seeks an optimum path to the solution of the governing set of several simultaneous nonlinear partial differential equations. This paper looks at recent advances in the modeling of combustor swirl flows, its aim being to review the difficulties, discuss developments, demonstrate that useful predictions are already being made, and indicate in what areas further research may be useful. (Author)

A75-20488 # Failure analyses of aircraft accidents. III. J. B. Shah (Ministry of Transport, Engineering Laboratory, Ottawa, Canada). *Metals Engineering Quarterly*, vol. 15, Feb. 1975, p. 33-39.

Failures due to abnormal cyclic loading are investigated. Excessive operating stresses and poor maintenance were the chief culprits. Examples covered include nose gear forks, overheated cylinders, weld failures, corrosion cracks, hydrogen embrittlement, and abnormal wear. Numerous photographs of the failure phenomena are given. S.J.M.

A75-20494 Correction of the usual boundary layer equations for the side least exposed to the flow on a cone at angle of attack (Sur une correction des équations usuelles de la couche limite du côté le moins exposé au vent d'un cône en incidence). B. Roux and B. Forestier (Aix-Marseille, Université, Marseille, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques*, vol. 279, no. 26, Dec. 23, 1974, p. 625-628. 7 refs. In French.

The results obtained show that it is possible to secure a physically acceptable solution for the azimuthal component of the reduced velocity vector. This study is only a stage in the analysis of the effect of the distance from the apex of the cone and of the angle of attack on the extent of the region of ellipticity. S.J.M.

A75-20635 # Research on similarity modeling of gas turbine combustion chambers operating with combustible gases. III (Recherches sur le modelage par similitude des chambres de combustion pour les turbines à gaz fonctionnant à combustible gazeux. III). D. Ursescu and V. Zubcu (Iasi, Institutul Politehnic, Iasi, Rumania). *Iasi, Institutul Politehnic, Buletinul, Sectia IV - Mecanica Tehnica*, vol. 20 (24), no. 1-2, 1974, p. 59-66. In French.

Experiments undertaken to verify and determine the domain of application of prior theoretical modeling conditions are analyzed. Only systems with reduced pressure and speed were experimentally investigated, since these systems are the most difficult to model. The prototypes matched well with their theoretical counterparts. S.J.M.

A75-20655 Spatial stability of some Falkner-Skan profiles with reversed flow. H. Taghavi and A. R. Wazzan (California, University, Los Angeles, Calif.). *Physics of Fluids*, vol. 17, Dec. 1974, p. 2181-2183. 6 refs. NSF Grant No. GK-39892.

The Orr-Sommerfeld equation is solved numerically for the boundary layer profiles which are the solutions to Stewartson's branch of the Falkner-Skan equation. These profiles are of significance in describing postseparation flows with negative skin friction. The cases considered are for the Hartree pressure gradient parameter $\beta = -0.18, -0.15, -0.10$, and -0.05 . The profiles become more stable as β decreases from -0.05 to -0.18 in contrast to the results of the Falkner-Skan similarity profiles with positive skin friction. (Author)

A75-20669 Aeronautics - A study in technological and economic growth and form /63rd Wilbur and Orville Wright Memorial Lecture/. A. H. Flax (Institute for Defense Analyses, Washington, D.C.). *Aeronautical Journal*, vol. 78, Dec. 1974, p. 537-552. 15 refs.

Relations between technology, aeronautics, and national priorities are examined. Questions concerning the economic growth in aeronautics are considered along with the evolution of aircraft engineering and its infrastructure, the cost of developments, and the fine structure of technological advance. Economic questions related to the rate of growth of aeronautical technology are explored and attention is given to the public interest in new technological developments. G.R.

A75-20670 The effect of deflecting flaps on strike/fighter aircraft wing design. D. R. Stanniland (Hawker Siddeley Aviation, Ltd., Brough, Yorks, England). *Aeronautical Journal*, vol. 78, Dec. 1974, p. 553-559.

Attention is given to a method for the incorporation of flap deflections into the design conditions as a means for the improvement of general performance without a degradation concerning any of the individual requirements. The effects of the design requirements are investigated and attention is given to the improvements found in many flight conditions. Disadvantages are related to a small reduction in maximum lift at low to intermediate subsonic Mach numbers and a possible reduction in maximum lift in the take-off and landing configurations. G.R.

A75-20689 The Mach number dependence of the stagnation point heat transfer in supersonic flow. H. W. Stock (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genève, Belgium). *International Journal of Heat and Mass Transfer*, vol. 18, Feb. 1975, p. 332-334. 6 refs.

A simplified expression for the Mach number dependence of the film coefficient at the stagnation point of spheres and cylinders in supersonic flow is presented. It is assumed that the gas is a perfect gas, that the velocities of sound at the outer edge of the boundary layer and at the stagnation point are equal, that the velocity gradient is constant, and that the Prandtl number is equal to unity (this is later corrected for). S.J.M.

A75-20773 Dynamic behavior of an F27 aircraft with damage to the flight-control system (Comportamento dinamico di un velivolo F27 con avaria ai comandi di volo). F. Bosman (Roma, Università, Rome, Italy). *L'Aerotecnica - Missili e Spazio*, vol. 53, Dec. 1974, p. 389-395. In Italian.

The study was made to determine the causes of the crash of a Fokker F27 aircraft on Apr. 16, 1972, on a regular airline flight. It was hypothesized that the aircraft suffered damage to the flight-control system such that the elevator became uncontrollable and, through mechanical interference with the stabilizer, began to oscillate under the influence of aerodynamic and inertial forces. Simulations run according to this hypothesis are in agreement with data supplied by the flight recorder. The hypothesis is also consistent with the structural damage done to the aircraft. A.T.S.

A75-20775 Dangers represented by jet aircraft with running engines (Peligro - Reactores en marcha). J. A. Martinez Cabeza. *Revista de Aeronáutica y Astronáutica*, vol. 34, Dec. 1974, p. 937-947. In Spanish.

It is pointed out that jet aircraft with running engines present a certain danger for persons and objects located in the vicinity of the aircraft. Attention is given to precautionary measures which should be adopted with respect to the jet engines currently in service. Effects produced by running jet engines are examined, taking into account detailed information concerning the hot gas emission. Questions regarding the zones of maximum danger under various conditions are explored and recommendations are made for adequate safety measures. G.R.

A75-20782 # Motion of a system of many particles in the wake of a gas (Rukh sistemi bagat'okh chastinok u suputnomu pototsi gazu). I. M. Sulima (Akademiia Nauk Ukrain'skoi RSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrain'skoi RSR, Dopovidi, Seriya A - Fiziko-Tekhnichni i Matematichni Nauki*, vol. 36, Dec. 1974, p. 1101-1104. In Ukrainian.

Analytic relations are obtained for the functions determining the steady motion of a many-particle system in a gas wake. Numerical analysis shows that the density of the particles has regions of rarefaction and compression. P.T.H.

A75-20789 Intensity, spectrum, and directivity of turbulent boundary layer noise. C. K. W. Tam (Florida State University, Tallahassee, Fla.). *Acoustical Society of America, Journal*, vol. 57, Jan. 1975, p. 25-34. 15 refs. NSF Grant No. GK-35790.

The problem of noise radiated from a turbulent boundary layer is studied. It is found that the farfield noise power, spectrum, and directivity can be determined completely if the nearfield pressure cross-correlation function is known. The role of supersonic and subsonic pressure components associated with the turbulent boundary layer in relation to noise radiation is examined. By using an empirical model of wall pressure cross-correlation function, it is found that the directivity pattern of turbulent boundary layer noise differs considerably from that of a free dipole. One principal reason for this difference is the fact that the noise sources of a turbulent boundary layer are constantly in motion. The effect of mean flow outside the boundary layer on the radiated noise power and spectrum is also investigated. Numerical results indicate that this effect is very important for low frequency noise components and for a high subsonic flow Mach number. (Author)

A75-20801 A novel procedure for assessing the accuracy of hyperbolic multilateration systems. H. B. Lee (MIT, Lexington, Mass.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-11, Jan. 1975, p. 2-15. 11 refs. Research supported by the U.S. Department of Transportation.

This paper describes a novel procedure for determining the accuracy of hyperbolic multilateration systems. Basically, the procedure links the conventional accuracy measures (e.g., GDOP) to the moments and products of inertia of a mass configuration that is easily derived from the system geometry. Thus, the problem of determining accuracy measures is reduced to that of calculating simple moments and products of inertia. The insight provided by the procedure makes it possible to derive a variety of useful approximations for GDOP and other accuracy measures. (Author)

A75-20802 Accuracy limitations of hyperbolic multilateration systems. H. B. Lee (MIT, Lexington, Mass.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-11, Jan. 1975, p. 16-29. Research supported by the U.S. Department of Transportation.

A recently developed procedure for assessing the accuracy of hyperbolic multilateration systems makes it easy to determine basic limitations on accuracy. This paper illustrates how such bounds can be derived. The results include bounds for a variety of geometries that are representative of practical ground-based and satellite-based hyperbolic systems. The results are applicable whenever the ranging errors can be treated as uncorrelated zero-mean random variables. In some cases the bounds quantify general knowledge (e.g., the directional dependence of errors). In other cases the bounds represent entirely new limitations (e.g., optimum accuracies for sector-restricted and cone-restricted transmitter/receiver configurations). (Author)

A75-20830 AMST - A Hercules for the 1980s. *Flight International*, vol. 107, Jan. 30, 1975, p. 147-155.

The Boeing YC-14 and the McDonnell Douglas YC-15, collectively known as the Advanced Medium STOL Transport (AMST) program, are examined. The AMST is intended to replace the C-130 Hercules in the field of mass transport. Interest shifted early to short runway performance. By virtue of the very high induced drag in STOL operation (the lift coefficients are about 4-5), both aircraft are flying on the backs of very steep drag curves. Flight control for the YC-14, the closest of the two aircraft to completion, is outlined.

S.J.M.

A75-20882 Effect of a general aviation trainer on the stress of flight training. C. E. Melton, J. M. McKenzie, J. R. Kelln, S. M. Hoffmann, and J. T. Saldivar (FAA, Civil Aeromedical Institute, Oklahoma City, Okla.). *Aviation, Space, and Environmental Medicine*, vol. 46, Jan. 1975, p. 1-5. 18 refs.

Sixteen students were given flight training according to a highly standardized and rigidly controlled 35-hr syllabus. Eight of the group (TG) received 10 hr of their training in a Link GAT-1 ground trainer and 25 hr in a Cherokee 140B. The other eight (AG) received all of their training in the airplane. The resting heart rate, physical work, as indicated by O₂ consumption, and urine chemistry were measured. Objective flight tests administered four times during the syllabus indicated insignificant differences between TG and AG. Likewise, a check pilot who did not know to which group a student belonged could not differentiate between groups TG and AG. It was concluded that 10 hr training in the GAT-1 did not compromise the flying skill as judged by the check pilot. (Author)

A75-20897 Accident statistics and the human-factor element. J. S. Shuckburgh (Civil Aviation Authority, Directorate of Flight Safety, London, England). *Aviation, Space, and Environmental Medicine*, vol. 46, Jan. 1975, p. 76-79.

The number of fatal accidents involving public transport aircraft has increased significantly in recent years and, because more and more wide-bodied aircraft have been coming into service, this has resulted in a rapid increase in the number of fatalities. A combined attack on the problem by all concerned with flight safety is required to improve the situation. The collection and analysis of aircraft accident data can contribute to safety in two ways: by giving an indication of where to concentrate future effort and by showing how successful past efforts have been. An analysis of worldwide accident statistics by phase of flight and causal factor shows that the largest percentage of accidents occurs in the approach and landing phase and are caused by pilot error. (Author)

A75-20898 Air crash survival - Injuries and evacuation toxic hazards. S. R. Mohler (FAA, Office of Aviation Medicine, Washington, D.C.). *Aviation, Space, and Environmental Medicine*, vol. 46, Jan. 1975, p. 86-88. 7 refs.

Carbon monoxide and cyanide gas have resulted from inflight or post-crash fires which have pyrolyzed certain cabin interior materials. Three air carrier accidents have been studied in depth from the standpoint of carbon monoxide effects on passengers. Post-crash hydrogen cyanide in victim blood levels has similarly been investigated and certain laboratory synergistic studies of carbon monoxide and hydrogen cyanide have been conducted. The latter investigations indicate that a combination of carbon monoxide and hydrogen cyanide has a pharmacologic effect which exceeds that of either alone. The effect is that of incapacitation, and certain remedial steps are possible which diminish the production of these substances during post-crash fires. (Author)

A75-20986 # Developments in metals for aircraft. L. Sanderson. *Aircraft Engineering*, vol. 47, Jan. 1975, p. 3-6.

Possibly the most important advances are related to the development of materials for jet engine components which are subjected to high temperatures. These materials include multiphase alloys designed for high strength and ductility at high operational temperatures. Developments in the area of superalloys are discussed along with a new series of steels, the introduction of new alloys, advanced production processes, aluminized alloy castings, and a new directionally solidified eutectic turbine alloy. G.R.

A75-20987 # Advance materials and processing techniques. S. J. Ashton and J. F. Cleave (High Duty Alloys, Ltd., Slough, Bucks., England). *Aircraft Engineering*, vol. 47, Jan. 1975, p. 7-13.

Conventional materials considered include the two aluminum alloys Hiduminium 48 and Hiduminium 54, which have been developed for airframe and engine applications, respectively. Unconventional materials are also examined, taking into account the use of boron filaments, SiC whiskers in aluminum, and materials obtained with the aid of extremely rapid cooling from the liquid or vapor phases. Precision forgings are discussed along with low internal stress complex die forgings and future hot working techniques. Attention is given to the beta forging of titanium alloys, diffusion bonding, isothermal forging, superplasticity, and hot isostatic pressing. G.R.

A75-20988 # High temperature alloys for gas turbines. H. Gaytor (Henry Wiggin and Co., Ltd., Hereford, Herts., England). *Aircraft Engineering*, vol. 47, Jan. 1975, p. 14-20.

It is pointed out that a wide range of creep resistant nickel-base alloys has been developed primarily for use at elevated temperatures in the gas turbine engine. Nominal compositions of some wrought high-strength nickel-base alloys are shown along with the basic compositions of some nickel-base casting alloys. Questions of alloy structure are discussed along with the precipitation of the hardening phase, the carbide phases, and the effects of service. Properties for applications are considered, taking into account turbine blade alloys, turbine disk alloys, alloys for sheet constructions, and alloys for shafts and rings. Attention is given to dispersion-strengthened materials and atomized powder products. G.R.

A75-20989 # Advanced materials in future aircraft design. R. G. Dabbs (Hawker Siddeley Aviation, Ltd., Kingston on Thames, Surrey, England). *Aircraft Engineering*, vol. 47, Jan. 1975, p. 21-24.

Specific fighter-type requirements are considered along with the application of structural materials and the reduction in cost to be obtained by the development of materials which require less expensive manufacturing techniques than currently employed materials. Metallic materials examined include aluminum alloys, titanium and its alloys, steels, and alloys based on cobalt, nickel, or niobium. Nonmetallic materials are also discussed, giving attention to fiber-reinforced composites and to transparent materials. G.R.

A75-20990 New high strength aluminium alloy. H. A. Holl (Ministry of Defence /Procurement Executive/, London, England). *Aircraft Engineering*, vol. 47, Jan. 1975, p. 25-32. 9 refs. Research supported by the Ministry of Defence (Procurement Executive).

Information is presented on the properties and the potential applications of a new aluminum-zinc-magnesium-copper alloy. The properties of the new alloy are compared with the properties of aluminum alloys currently used for airframe construction. Questions of alloy composition, heat treatment, and metallurgical characteristics are considered. Attention is given to tensile properties, stress-corrosion resistance, exfoliation corrosion resistance, fracture toughness, fatigue strength and crack propagation resistance, and properties of product forms other than plate. G.R.

A75-20991 # Development of an improved elevated temperature aluminium alloy Alcan GBX 158. *Aircraft Engineering*, vol. 47, Jan. 1975, p. 32, 33.

A75-20992 # Titanium in aerospace. *Aircraft Engineering*, vol. 47, Jan. 1975, p. 34, 35, 41.

It is pointed out that the aerospace industry consumed 75 per cent of the 15,000 tons of titanium produced in the U.S. during 1974. Titanium-base alloys have high strength and stiffness, useable ductility, corrosion resistance, and lower density than most other structural metals. The development characteristics of the alloys are discussed along with advances in casting technology and the advantages inherent in a use of titanium castings. G.R.

A75-20993 # Specialised rubber moulding at Weybridge. W. J. Bird, E. E. Cox, and P. Paull (British Aircraft Corp., Ltd., Commercial Aircraft Div., Weybridge, Surrey, England). *Aircraft Engineering*, vol. 47, Jan. 1975, p. 36-41.

In connection with a particularly demanding project requiring the use of a synthetic-rubber material of certain specific characteristics, a research program was organized with the objective to obtain needed data. The investigation showed that in response to the requirements of the project a one-piece synthetic rubber moulding could be designed and manufactured. The characteristics of the new sealing device are discussed. Attention is also given to oscillatory devices and questions of cost-efficient manufacture. G.R.

A75-21012 Dogfighter supreme - The Tomcat. D. W. H. Godfrey. *Air Enthusiast International*, vol. 6, Jan. 1974, p. 7-16, 46, 47.

The concept and characteristics of the F-14A Tomcat are described. Of note are the fully sweepable wings, large intake area, and low-speed stability, as well as the high-g turn capacity. A detailed cutaway drawing and several photographs of prototypes are included. Naval needs, configuration compromises, progress and problems, design features, power plant installation, weapon systems, and developments and prospects are the major topics discussed. S.J.M.

A75-21013 A new vertical approach. G. O'Rourke. *Air Enthusiast International*, vol. 6, Feb. 1974, p. 64-68.

The philosophy of the Rockwell XFV-12A thrust-augmented wing V/STOL prototypes is explained. For VTOL, a four poster effect is achieved through the use of both wings and canards as jet ejectors: when engine air is exhausted through these large lateral nozzles, an eight-fold increase in airflow results. The thrust-augmented wing design overcomes the downwash problem. Due to aerofoil-located ejectors, excellent STOL performance is possible. Transition from wing-borne to engine-borne flight prior to vertical landing is difficult, however, and limits the craft's all-weather potential. Implications in the field of the supercarrier are delineated. A detailed cutaway drawing of the XFV-14A is included. S.J.M.

A75-21014 Northrop's new fighter generation. *Air Enthusiast International*, vol. 6, Mar. 1974, p. 105-108, 146.

The USAF launched its Light Weight Fighter (LWF) program by releasing a request for proposals on January 6, 1972. In response to the LWF concept Northrop was able to submit the P-600 as a derivative of an existing design, the P-530 Cobra. The Cobra project had been started in mid-1966 as a successor to the highly effective F-5 series. The design of the YF-17 (as the P-600 has been designated) is discussed. The YF-17 airframe is primarily aluminum with the use of titanium and steel limited to those areas subjected to high stress or heat soak. The Cobra/YF-17 designs are powered by the new YJ101-GE-100 engine. G.R.

A75-21015 The Fairchild A-10A - More thunder for the USAF. *Air Enthusiast International*, vol. 6, May 1974, p. 219-225, 263.

The Fairchild A-10A is an attack aircraft specifically designed for the close air support mission. Deliveries of the aircraft to the USAF are to be made during the period from 1975 to 1979. The aircraft is to have a combat speed at sea level of 741 km/hr. Aircraft

specifications are discussed along with aircraft structure and systems, weapons, and aspects of flight testing. Modifications have been introduced to overcome a tendency to engine stalling encountered at high angles of attack. G.R.

A75-21016 **Fixer, finder, striker - The S-3A Viking.** D. W. H. Godfrey. *Air International*, vol. 7, July 1974, p. 5-13.

The S-3A Viking is an aircraft designed to solve the anti-submarine warfare tactical problem. Aspects regarding the background of the development of the new aircraft are examined and attention is given to questions of aerodynamic evolution, approaches used for submarine detection, details regarding the avionics systems, search and attack stores, and plans for derivative versions of the aircraft. G.R.

A75-21017 **Lightweight fighter - The general dynamics approach.** *Air International*, vol. 7, Aug. 1974, p. 59-63, 88, 89.

According to a Request for Proposals (RFP) issued on Jan. 6, 1972, prototypes were to be built in order to demonstrate the technology that was available to produce a low-cost, highly-maneuverable fighter using advanced aerodynamics and new materials as appropriate. In connection with the RFP the YF-16 was developed. Advanced features of the aircraft are discussed along with low-cost considerations, questions of armament and avionics, and aspects of aircraft testing. G.R.

A75-21018 **Lockheed's Lone Ranger - Reconnoitring at Mach 3.** *Air International*, vol. 7, Oct. 1974, p. 159-166, 203.

A description is given of the program that produced the SR-71 and its forerunner, the YF-12, in response to performance requirements involving sustained supersonic cruise faster than Mach 3.0 and a sustained altitude capability above 24,400 m. Questions of aerodynamic and thermodynamic design are considered along with details regarding the turbo-ramjet powerplants. Attention is given to flight procedures and the use of the aircraft in NASA studies. G.R.

A75-21035 **Flight measurements as part of the testing of electric deicing equipment for helicopter rotor blades (Flugmessungen im Rahmen der Erprobung einer elektrischen Enteisungsanlage für Hubschrauber-Rotorblätter).** L. Kirschke (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugzeugbau, Braunschweig, West Germany). *DFVLR-Nachrichten*, Dec. 1974, p. 589-591. In German.

The principles of operation of electrical rotor blade deicing equipment are considered. An investigation of the operational characteristics of electrical deicing equipment developed by a German firm was conducted in two groups of tests related to the use of the equipment with a Sikorsky H 34 G helicopter in winter and in summer. Particular attention is given to the measurement of blade temperatures and control-rod forces. Details regarding the measuring devices are considered and the measurement results are discussed. G.R.

A75-21036 **Modern procedures for cooling turbine blades (Moderne Verfahren zur Kühlung von Turbinenschaufeln).** H. Kruse (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Luftstrahlantriebe, Porz-Wahn, West Germany). *DFVLR-Nachrichten*, Dec. 1974, p. 592-594. In German.

Approaches based on convection cooling are considered along with methods providing a protective cooling film by means of air entering the space above critical component locations through openings in the material. An advanced cooling method of great promise is based on effusion cooling. Attention is given to investigations conducted with the objective to develop new efficient and practical film and effusion cooling processes for turbine blades. G.R.

A75-21037 **The use of boron/lithium in the combination ram jet/rocket engine (Die Verwendung von Bor/Lithium in der**

Kombination Staustrahl-/Raketentriebwerk). R. Mestwerdt, J. Kolodzey, and H. Selzer (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für chemische Raketenantriebe, Trauen, West Germany). *DFVLR-Nachrichten*, Dec. 1974, p. 595-597. In German.

The development of a ram jet/rocket engine has the objective to lower the high propellant consumption of a conventional booster stage. The performance of the engine can be improved by the admixture of metallic particles to the fuel. Certain problems inherent in a use of boron as fuel additive can be overcome by employing a material consisting of a mixture of boron with lithium. Details regarding the development of the new process are discussed along with spectroscopic studies of the combustion mechanism involved. G.R.

A75-21040 **Turbulence therapy, a new treatment of jet aircraft noise (Turbulenztherapie - Eine neue Behandlung des Strahlärms).** H. V. Fuchs (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Turbulenzforschung, Berlin, West Germany). *DFVLR-Nachrichten*, Dec. 1974, p. 602, 603. In German.

The origin of jet aircraft noise is briefly considered along with approaches for reducing this type of noise. It is pointed out that in none of the developed approaches attention is given to the possibility to affect the turbulence of the jet flow. The investigation considered is concerned with a new concept for the description of jet turbulence and jet aircraft noise. It is to be attempted to develop an approach for reducing jet aircraft noise with the aid of methods which will affect the turbulence structure. G.R.

A75-21045 # **Impact damage effects on boron/aluminum composites.** J. C. Carlisle, R. L. Crane (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio), L. T. Montulli (USAF, Institute of Technology, Wright-Patterson AFB, Ohio), and W. J. Jaques. *Metallurgical Society of AIME, Symposium on Failure Modes in Composites II, Pittsburgh, Pa., May 19-23, 1974, Paper. 25 p. 16 refs.*

The foreign-object-damage problem associated with jet engines was investigated by impacting both Ti (6Al-4V) and boron/aluminum specimens with either steel or RTV spheres in order to simulate the two principal types of ingested foreign objects. To simulate engine operating conditions some specimens were impacted while under a tensile load. Results indicate that prestress composite suffers much greater damage than simple cantilevered specimens. Ti-6Al-4V exhibits excellent impact resistance, losing only 10% of its UTS up to the highest prestresses and impact velocities. Composite specimens react much differently depending on the type of impactor. (Author)

A75-21106 # **Numerical analysis of the leading-edge problem on the basis of the complete Boltzmann equation (Chislennoe issledovanie zadachi o perednei kromke na osnove polnogo uravneniya Bol'tsmana).** S. Ia. Shcherbak. *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia*, Oct. 1974, p. 109-115. 9 refs. In Russian.

The sharp leading-edge problem is analyzed for a free-stream Mach number of 1.5 and a ratio of the plate temperature to the flow temperature of 1.5. The complete Boltzmann equation is solved by a method developed by Shcherbak (1972) for the problem of nonlinear relaxation of a pseudo-shock. It is shown that the Bhatnagar-Gross-Krook model used by Huang and Hartley (1969) to study the supersonic sharp leading-edge problem does not correctly reflect the influence of the plate on the macroparameters of the flow. V.P.

A75-21119 **EB welding teams up with NDT techniques to improve production of Grumman's F-14 supersonic swing-wing fighter plane.** *Welding Journal*, vol. 54, Feb. 1975, p. 97-100.

The use of electron beam (EB) welding together with tight quality control procedures has made it possible to obtain a 50% improvement in welding proficiency. Details regarding the EB welding process used for the titanium components of the F-14 are discussed along with aspects of nondestructive testing. Attention is given to ultrasonic inspection, radiography, and dye penetrant inspection. G.R.

A75-21154 # Analysis of a dynamic vibration absorber for helicopter blades. Y. Yamamoto, S. Ando (Nagoya University, Nagoya, Japan), and H. Ishigaki (Hitachi Ship Building Engineering Co., Ltd., Osaka, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 17, Dec. 1974, p. 187-198.

An analysis is presented for the Frahm-type blade-vibration-absorber (BVA) when the second flapwise bending natural circular frequency (ω_2) coincides with three per revolution. The rate of change in ω_2 with an increasing mass of BVA is drastic for the smaller mass ratio, but becomes mild for the larger one. For the purpose of comparison, the effect of a simply fixed weight is also investigated. The effect of BVA is much larger than that of the fixed weight for the same mass ratio in both devices, if the mass ratio is reasonably small and if the station does not coincide with modal shape nodes. (Author)

A75-21476 Laminar flow behavior under slip-boundary conditions. H. J. Lugt and S. Ohring (U.S. Naval Material Command, Ship Research and Development Center, Bethesda, Md.). *Physics of Fluids*, vol. 18, Jan. 1975, p. 1-8. 25 refs.

Laminar flows past bodies under slip-boundary conditions are investigated theoretically within the framework of the Navier-Stokes equations. The numerical solutions to the equations are obtained using newly developed computer programs for incompressible fluid flows past elliptic cylinders and oblate spheroids. The influence of slippage on flow separation, vorticity, and vortex shedding, as well as on the force coefficients, is discussed. (Author)

A75-21548 # Self-excited acoustic oscillations in combustion areas with flat flames (Selbsterregte akustische Schwingungen in Brennräumen mit flachen Flammen). H. Schimmer. München, Technische Universität, Fakultät für Maschinenwesen und Elektrotechnik, Doktor der Naturwissenschaften Dissertation, 1974. 134 p. 84 refs. In German.

It is the objective of the reported investigation to obtain with the aid of an approximately one-dimensional system experimental results as a basis for the identification of the mechanism responsible for the excitation of the oscillations. Particular attention is given to thermoacoustic interchange effects between flame and burner. It is found that the oscillations can be explained with the aid of the Rayleigh criterion, taking into account an unsteady heat loss related to the transfer of heat from the flat flame to the burner. The heat loss process is approximately in phase with the acoustic intensity. G.R.

A75-21563 Perspectives of the European aerospace industry. I (Perspektiven der europäischen Luftfahrtindustrie. I). C. Dornier, Jr. *Flug Revue/Flugwelt International*, Feb. 1975, p. 29-33. In German.

The prospects of the European aerospace industry for the future are examined, giving attention to opportunities presented by the development of the supersonic airliner Concorde. Possibilities for other new developments are considered, taking into account a development schedule involving a time of about 10 years and financial contributions from individual European countries in a joint venture. The situation for European developments appears to be favorable in V/STOL technology areas. Opportunities inherent in the development of large cargo-transport aircraft are discussed. G.R.

A75-21564 ARTS III computerized air traffic control system. R. T. Hawk (U.S. Army, Fort Rucker, Ala.). *Signal*, vol. 29, Feb. 1975, p. 6-8, 10.

Reasons for adoption of the ARTS III (Automated Radar Terminal System) at Cairns Army Radar Approach Control (ARAC), Fort Rucker, Alabama, are given. A qualitative description of the system discusses modifications to existing ARAC systems, capabilities available at Rucker, and the three major subsystems of the ARTS III: data acquisition, data processing, and communications key-boards. S.J.M.

A75-21711 # 'MADGE' - A microwave aircraft digital guidance equipment. I - General principles and angle-measuring units. R. N. Alcock, D. A. Lucas, and R. P. Vincent (Mullard, Ltd., Salfords, Surrey, England). *Philips Technical Review*, vol. 34, no. 9, 1974, p. 225-241.

The present work gives a general description of MADGE, a microwave guidance aid for aircraft landing which provides guidance along many approach paths at differing angles and meets the requirements of a wide variety of aircraft: fixed-wing, vertical and short take-off, and helicopters. The angular accuracy of MADGE is about 0.05 deg, which is equivalent to that of a Category II standard ILS system. The pilot can select his desired approach angle; horizontal and vertical displacement errors and distance to the runway are displayed in the aircraft. The battery-operated ground equipment is portable and can be set up quickly in a variety of temporary landing sites. Angle measurement with multiple interferometers is described, including ambiguity resolution and possible phase errors. Phase-measuring receivers and the azimuth and elevation units are also described. P.T.H.

A75-21715 Prospects for the airborne Omega system in zone navigation (Les espérances de l'Oméga aéroporté en navigation de zone). S. Jacquelin (Centre d'Essais en Vol, Brétigny-sur-Orge, Essonne, France). *Navigation (Paris)*, vol. 23, Jan. 1975, p. 35-44. In French.

Results of ongoing studies of the airborne Omega system are examined in the perspective of its potential use as a means of surface navigation, particularly in France and along the French Atlantic coast. Installation of the system on an aircraft, actual flight events from the experiments, and remedies to some of the problems encountered are presented. S.J.M.

A75-21724 # The automation of air traffic control. J. Villiers. *Journal of Navigation*, vol. 28, Jan. 1975, p. 25-30.

The present work discusses some of the psychological problems encountered in attempts to automate the functions of the air traffic controller. Between the two evils of technophobia and technocracy, there is still one royal road: the geometrical method provides a more powerful tool for instruction than a fine intuition does for explanation. To combine the two within a modern research team is to try to rediscover the 'man of reason' and to provide him with the facilities for study and action in keeping with the needs and aspirations of our times. P.T.H.

A75-21725 # Air navigation with a pocket electronic calculator. J. D. Proctor. *Journal of Navigation*, vol. 28, Jan. 1975, p. 104-109.

The present work gives some examples in the calculation of rhumb-line course, distance, and winds with the aid of a pocket electronic calculator. The device replaces conversion tables and various mathematical tables, and it can replace to a large extent plotting charts, flight planning charts, Dalton computers, protractors, and dividers. P.T.H.

A75-21800 # A numerical study of some drag coefficients. S. Popp. *Revue Roumaine de Mathématiques Pures et Appliquées*, vol. 19, no. 6, 1974, p. 811-824. 10 refs.

Numerical calculations based on formulas established in some previous papers, especially those related to the expressions of the

drag coefficients. The obstacle is a symmetrical wedge. The results are presented in the form of numerous tables and graphs (drag coefficient vs ratio of velocity at infinity upstream to free stream speed). The drag coefficient on the obstacle increases with the angle subtended by the sides of the wedge, becoming maximum at an angle of π , and it decreases with increasing upstream-free stream velocity ratio. If this ratio remains constant, the drag coefficient decreases with increasing downstream-free stream velocity ratio. When downstream equals free stream velocity, at wedge angles greater than 120 deg, the drag coefficient values are very close to one another; at angles between 20 and 120 deg, they differ greatly. S.J.M.

A75-22011 Intensity fluctuations of aircraft flyover noise. R. H. Gonter (Massachusetts, University, Amherst, Mass.). *Acoustical Society of America, Journal*, vol. 57, Feb. 1975, p. 273-275.

Aircraft flyover noise was recorded and played back with a peak detector to detect the intensity fluctuations. The intensity fluctuations were digitized and plotted. Jet noise fluctuations appear more jagged, while prop noise fluctuations are smoother. Spectral analysis of fluctuations shows most of the power is at low frequencies and decreased by 80 dB between 0 and 5 Hz. (Author)

A75-22017 Stability of an axial flow compressor with steady inlet conditions. A. G. Corbett (Leicester, University, Leicester, England) and R. L. Elder (Cranfield Institute of Technology, Cranfield, Beds., England). *Journal of Mechanical Engineering Science*, vol. 16, Dec. 1974, p. 377-385. 8 refs. Research supported by the Rolls-Royce (1971), Ltd. and Science Research Council.

For modern jet engines, it is necessary to assess the effect of pressure and temperature transients on the performance and stability of axial flow compressors at constant speed. To this end, a series of mathematical models of varying complexity are derived which describe the dynamic behavior of an axial flow compressor as a set of nonlinear differential equations. The models are based on the principles of conservation of mass, linear momentum, and energy applied to one-dimensional flow. Steady-state characteristics are used to introduce the effects of blading. The analysis is carried out for a seven-stage compressor. Good agreement is found between experimental surge points and the stability limits predicted by all models. V.P.

A75-22018 Secondary flow in cascades - Two simple derivations for the components of vorticity. P. M. Came (National Gas Turbine Establishment, Farnborough, Hants., England) and H. Marsh (Durham, University, Durham, England). *Journal of Mechanical Engineering Science*, vol. 16, Dec. 1974, p. 391-401. 6 refs.

By considering a many-bladed cascade, two simple theories are developed for secondary flow in cascades. Following the work of Hawthorne, three components of vorticity are identified at exit from the cascade. An expression is obtained for the difference in the time taken for fluid particles to travel over the two surfaces of the blade, and this is used to derive the governing equations for the distributed secondary, trailing filament and trailing shed vorticities. It is shown that, for a many-bladed cascade, the total secondary circulation in the downstream flow is zero. The calculation of secondary flow for a real cascade is discussed, and it is shown that earlier calculations of secondary flow at exit from cascades are consistent with this new approach. (Author)

A75-22019 Secondary flow in cascades - The effect of axial velocity ratio. H. Marsh (Durham, University, Durham, England). *Journal of Mechanical Engineering Science*, vol. 16, Dec. 1974, p. 402-407. 5 refs.

By considering the flow through a many-bladed cascade, a simple theory is developed for the effect of a change in axial velocity on the secondary flow at exit from a cascade. An expression is derived for the difference in the time taken for fluid particles to travel over the two surfaces of the blade and this is used, along with Kelvin's circulation theorem for incompressible flow, to obtain an

equation for the distributed secondary vorticity. It is shown that for the row of inlet guide vanes tested by Gregory-Smith, the change of axial velocity across the blade row has a significant effect on the secondary vorticity. (Author)

A75-22020 A surface vorticity analysis of three-dimensional flow through strongly swept turbine cascades. D. Graham and R. I. Lewis (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England). *Journal of Mechanical Engineering Science*, vol. 16, Dec. 1974, p. 425-433. 8 refs.

The two-dimensional surface vorticity theory of Martensen is extended to deal with the full three-dimensional flow through a swept turbine cascade, including end effects. Basic concepts of surface vorticity theories are dealt with initially, as also are three three-dimensional flow considerations for swept cascades. The paper goes on to develop two theoretical models for the representation of swept blade row flows. The first model assumes that the blade bound vorticity remains constant across the span of the blade. In the second model, this assumption is relaxed so that the blade bound vorticity is allowed to vary in the spanwise direction. In both cases the theories are applied to turbine nozzle cascades. Some of the solutions obtained are compared with experimental tests which were the subject of a previous paper. (Author)

A75-22034 Investigations on the design of rolleron flaps for the rolling damping of missiles (Untersuchungen zur Auslegung von Rolleronklappen für die Rolldämpfung von Flugkörpern). D. Jacob and S. Schultz (Dornier GmbH, Friedrichshafen, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 23, Jan. 1975, p. 24-32. In German.

The general equations of motion for a missile with rolleron flaps are derived and simplified for the case of pure rolling motion. The dynamic behavior is investigated by means of the simplified equations and discussed for special cases. Examples for the stability behavior and for forced oscillations of the flap motion show the influences of the individual parameters such as Mach number, moments of inertia, angular momentum of gyro, hinge damping and aerodynamic derivatives. Design criteria are developed from the results. (Author)

A75-22076 Influence of friction and heat exchange on flow specific impulse. V. E. Alemasov, Iu. M. Danilov, and A. F. Dregalin. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 5-8.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 1-4. 9 refs. Translation.

Simple but accurate relations are derived, using which the impulse losses by friction can be calculated in terms of heat transfer losses computed on the basis of the laws of thermodynamics. This eliminates the need for additional allowance for impulse losses associated with heat transfer, when the friction losses are determined on the basis of boundary layer theory. V.P.

A75-22077 Motion of vaporizing fuel drop in mechanical injector plume. S. V. Ananikov and A. V. Talantov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 9-14.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 5-9. 9 refs. Translation.

An analytical solution is obtained to the problem of the unsteady motion of an isolated evaporating fuel droplet in the spray field of a fuel nozzle. Expressions are derived for calculating the velocities and dwell time of the droplet in the unsteady portion of its motion and for calculating the path traversed by the droplet. A relation for determining the size of the droplet during the evaporation process is obtained. V.P.

A75-22078 Optimization of aircraft gas turbine blade air cooling systems. I. E. N. Bogomolov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 15-24.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 10-17. 7 refs. Translation.

Analytical expressions are derived for calculating the relative drop in mean temperature of turbine blades due to internal air cooling, with allowance for the characteristics of the cooling system and of the cooling channels, for the gas parameters in the turbine, and for the flight conditions. The influence of preswirling the cooling air in front of the rotor is studied. Means of optimizing the system parameters are examined. V.P.

A75-22083 Experimental study of convergent nozzles. I. N. Denisov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 49-55.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 37-42. 10 refs. Translation.

The characteristics of conical and shaped converging nozzles with cant angles ranging from 0 to 90 degrees were studied experimentally. Radial diagrams of the parameters at the nozzle exit section are obtained, and the mean values of these parameters are determined. Expressions for calculating the thrust and discharge coefficients from the mean parameters are derived. It is shown that the thrust coefficient is practically independent of the nozzle cant angle. V.P.

A75-22085 Determination of cooling energy and air flow rate to cool turbine case. A. G. Karimova and N. S. Tkachenko. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 62-65.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 48-51. 6 refs. Translation.

A75-22086 Experimental study of ejectors for use in mechanizing BLC wing. I. I. Kalmykov, N. N. Kovai'nogov, and A. I. Matiazh. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 66-69.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 52-54. Translation.

Test data obtained for an ejector with a curvilinear channel in the absence of external flow are studied. The influence of the geometrical and gasdynamic parameters on ejector performance is analyzed. The applicability of an ejector scheme to the control of boundary layers on flaps is evaluated. V.P.

A75-22087 Heat transfer coefficients in radial gas turbine rotor flow passage during startup. V. I. Krichakin, V. S. Petrovskii, and A. M. Poliakov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 70-74.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 55-58. Translation.

A75-22089 Analysis of cooled turbine blades. V. I. Lokai, E. I. Gunchenko, and A. S. Limanskii. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 80-84.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 63-66. 13 refs. Translation.

In the calculation of cooled turbine blades on the basis of the absolute blade temperatures and their gradients, the accuracy of the calculated data depends strongly on the correlation between the calculated and actual values of the coefficients of heat transfer from the gas and from the coolant. The recommendations of various investigators concerning the calculation of the coefficients of heat transfer from the gas on the basis of calculated and experimental rotor blade temperatures are compared and critically analyzed. V.P.

A75-22090 Calculation of combustion process characteristics in high-temperature gas turbine engines. A. V. Mosin, A. V. Talantov, and V. A. Shchukin. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 85-91.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 67-70. 6 refs. Translation.

The length of the combustion zone and the proper dimensions of flame stabilizers in combustion chambers and afterburners of turbojet and turbofan engines are calculated for high gas temperatures in front of the turbine. It is shown that an increase in the gas

temperature in front of the turbine leads to better combustion conditions both in combustion chambers and afterburners. On the other hand, the conditions for flame stabilization in afterburners may be expected to deteriorate at temperatures above 2000 K in front of the turbine, while burnup may be impaired at temperatures above 2500 K in front of the turbine. The conditions for self-ignition in combustion chambers are examined. V.P.

A75-22094 Heat transfer on curved surfaces. A. V. Shchukin. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 106-110.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 83-87. 5 refs. Translation.

Heat transfer between a gas and walls can be studied through surface temperature gradients which are determined analytically from surface-temperature measurements. The present article presents an analytical method for determining the temperature gradients at curvilinear surfaces composed of elements with various shapes, such as are used in gas-turbine blades and channels of complex form. The method involves changing the coordinates in order to transform the curvilinear regions into a rectangular region for which the analytical solution is known. This eliminates the need to measure temperature distributions between elements. In practice, the gradients are calculated on a computer. A.T.S.

A75-22096 Heat transfer in radial-axial turbine flow passage. M. N. Bodunov and Iu. N. Chugunov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 115, 116.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 92, 93. 12 refs. Translation.

The article presents a description of an experimental set up for the investigation of heat transfer in different sections of a rotor wheel and the casing of a radial axial turbine. A schematic diagram and the fundamental dimensions of an experimental centripetal turbine and its flow area are presented. The investigation of heat transfer in this setup utilizes the method of regular, first-order thermal regime. T.S.

A75-22097 Study of heat transfer in turbine cascades at high gas flow velocities. M. N. Bodunov, M. U. Zakirov, Iu. N. Ivan'shin, and V. A. Podgornov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 117-119.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 94-96. 19 refs. Translation.

A single-stage supersonic experimental turbine and a supersonic wind tunnel are described, both of which were used to study the heat transfer characteristics of turbine blades, using air as the working medium. The heat transfer coefficients were determined by a calorimetric and a thermal technique (regular thermal regime of the first kind). The influence of high Mach numbers on the heat transfer from the gas to the frontal area of an aperture between plane turbine blades is studied. (Author)

A75-22100 Profiling radial-axial turbine stage inlet guide vanes. A. Ia. Ipatenko, A. Ia. Shkvar, and V. P. Voloshin. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 125-127.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 105, 106. 8 refs. Translation.

A75-22102 Influence of nozzle vane cant angle on variable stresses in cantilever turbomachine rotor blades. A. A. Kovalev, V. A. Strunkin, I. I. Kurtseva, and R. Sh. Manevich. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 130-133.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 110-112. Translation.

A75-22105 Heat transfer coefficients of gas turbine flow passage elements under rotating conditions. A. A. Panteleev, F. I.

Piatkov, and V. A. Trushin. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 138-142.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 119-123. 8 refs. Translation.

A75-22107 **Optimal design with several merit criteria.** A. P. Tunakov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 3, 1974, p. 146-148.) *Soviet Aeronautics*, vol. 17, no. 3, 1974, p. 128-130. Translation.

Existing optimization algorithms used in designing machines are usually developed for a single goal function (a single performance criterion). However, in view of the frequently contradictory requirements placed on complex machines, it is difficult to select a single goal function. It is shown that better results can be obtained by using a vector goal function that allows for several requirements differing in the degree of importance. Analysis shows that optimal designing should be limited to three or four performance criteria. V.P.

A75-22168 **The maintenance of aircraft, productivity, difficulty, and equivalence (El mantenimiento de aviones - Productividad, dificultad y equivalencia).** M. Cuesta Alvarez. *Revista de Aeronáutica y Astronáutica*, vol. 35, Jan. 1975, p. 34-47. 9 refs. In Spanish.

The concept of productivity and approaches for the determination of the productivity of an airline and its aircraft are considered. Attention is given to the equivalent maintenance factor of an aircraft as a function of aircraft utilization and the difficulty factor for a specific type of aircraft, taking into account an evaluation procedure based on functional systems. Questions of operational time, reliability, maintenance difficulty considerations, and the formulas for the determination of the various parameters are discussed. G.R.

A75-22184 **Diffraction of a plane wave on a wedge moving at supersonic speed under conditions of sporadic shock interaction.** L. E. Pekurovskii and S. M. Ter-Minasiants. (*Prikladnaia Matematika i Mekhanika*, vol. 38, May-June 1974, p. 484-493.) *PMM - Journal of Applied Mathematics and Mechanics*, vol. 38, no. 3, 1974, p. 448-456. 14 refs. Translation.

A75-22257 **Future cockpit displays.** J. H. Wharf and B. Ellis (Royal Aircraft Establishment, Farnborough, Hants., England). *Optics and Laser Technology*, vol. 7, Feb. 1975, p. 25-30. 11 refs.

As aircraft systems become more complicated it is necessary to display information which was either not previously available or was provided by instruments which were unduly bulky, heavy, expensive, or unreliable. This paper considers possible display mechanisms for future cockpits and their performance in high ambient illumination. Methods of optimizing the legibility of commercially available display types using contrast enhancement techniques are described. Finally the results of subjective tests on light emitting diode displays are discussed. (Author)

A75-22270 # **Non-adiabatic supersonic laminar flow past a small step or suction gap.** G. R. Inger (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 4, 1974, p. 635-653. 13 refs.

A general unified theory of small steady state disturbances in compressible boundary layers is applied to the problem of a high speed laminar flow past a small rear-facing step or suction gap. The important effects of the highly nonuniform flow within the boundary layer and viscous-inviscid interaction are taken into account, as there are surface heat and mass transfer, lateral pressure gradient and upstream influence in the disturbance field. Analytical solutions for the pressure, skin friction and heat transfer perturbations are obtained by Fourier transformation. Comparisons with a variety of experimental data show good agreement in several different features, including base pressure, upstream influence ahead of the step, and heat transfer. (Author)

A75-22272 **Helicopter technological progress. II - Bell Helicopter Co. B. Kelley. Vertiflite**, vol. 21, Jan.-Feb. 1975, p. 2, 3, 16.

This article continues a description of technological improvements made on Bell helicopters, presenting a broad, qualitative comparison between the two-bladed seesaw rotor system and the individually articulated system. There is no appreciable weight difference between the two systems, but a trend toward higher total blade weight in the two-blader and higher hub assembly weight in the articulated system. Noise is a distinct disadvantage in the two-blader, while ground resonance must be considered in designing articulated systems. The two-blader is less costly, easier to maintain and store, and has better tracking, ruggedness, ground operation in high winds and stall characteristics at high speed. Both systems are about equal in reparability and withstanding small arms fire. While the articulated system has better Zero G control, this is a questionable requirement, except in fighter helicopters. Both systems will continue to be developed and refined, although there are marked differences between them. F.G.M.

A75-22302 # **Graphic-analytic method for determining the absolute optimum shape of the thin delta wing in supersonic flow (Eine graphisch-analytische Methode zur Bestimmung der optimum-optimum-Form des dünnen Deltaflügels in Überschallströmung).** A. Nastase (Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 1, 1974, p. 15-35. 7 refs. In German.

The present work considers the variational problem of determining the optimum design of a thin delta wing under various geometric and aerodynamic constraints. Lift, pitching moment, and central profile of the aerofoil are prescribed, and the axial component of the perturbation velocity must be finite at the subsonic leading edge in order to avoid formation and shedding of vortices at cruising Mach number. Angle of attack is small enough so that theory of small perturbation can be applied. Vertical components of the perturbation velocity are expressed in the form of a finite superposition of homogeneous polynomials so that the theory of higher-order conical flow of Germain (1949) can be applied. Optimization consists in finding the value for the similarity parameter for which the air drag is minimized. P.T.H.

A75-22306 # **Some questions in the calculation of the strength of thin-walled aircraft structures through the application of mechanized computer techniques (Nekotorye voprosy rascheta na prochnost' tonkostennykh aviakonstruktsii s primeneniem mekhanizirovannoi vychislitel'noi tekhniki).** Iu. V. Vasil'ev. *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 1, 1974, p. 117-134. 23 refs. In Russian.

Analysis of a method for totally mechanized computer calculation of an aircraft fuselage structure based on beam theory. The calculations take into account complex bending and torsion loads with allowance for loss of stability of the fuselage cover, which is subject to compressive and shear stresses. A new expression for the reduction coefficient of the fuselage cover is used, and a typical logic scheme for computer implementation of the method is given. P.T.H.

A75-22307 # **Numerical method for supersonic aerodynamic characteristics of a wing-body system.** N. N. Patraulea, E. Malaiu, and R. N. N. Patraulea. *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 2, 1974, p. 151-161. 6 refs.

A finite difference method is given for computing the aerodynamic elements of a wing-body in supersonic flow. The body is supposed to be an infinite cylinder. Operating a conformal mapping of the exterior of the body cross-section on the exterior of a straight

cut of an auxiliary plane the problem is reduced to that of an isolated wing. (Author)

A75-22310 # A graphical-analytical method of determining the optimal shape of uniformly thick delta wings in supersonic flow (Eine graphisch-analytische Methode zur Bestimmung der optimum optimorum-Form des symmetrischdicken Deltaflügels in Überschallströmung). A. Nastase (Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 2, 1974, p. 191-208. 5 refs. In German.

The method is proposed for delta wings in a fixed area class, with certain geometrical constraints. The procedure hinges on the optimization of the wing design by finding the optimal value of the similarity parameter, which minimizes the wave drag expression. To this end a hypothetically symmetrical optimized wing with fixed planform is used, which depends only on this parameter. The uniformly thick, optimized wing would be moving in a suitably selected theoretical supersonic flow. S.J.M.

A75-22312 # Vibrations of a rigid rotor and pressure exerted on its supports, one of which is elastic and the other is hinged (Kolebania i davlenia na opory zhestkogo rotora, odna iz kotorykh vypolnena uprugoi, a drugaia sharnirnoi). A. S. Kel'zon and V. I. Priadilov (Leningradskoe Vyshee Inzhenernoe Morskoe Uchilishche, Leningrad, USSR). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 2, 1974, p. 231-246. 7 refs. In Russian.

The present work calculates the effects of static and dynamic imbalance of a rigid rotor on its two supports for the case when one of the supports is elastic and the other is hinged. These effects manifest themselves in the form of vibrations of the rotor and pressure exerted on the supports. The influence of viscous friction, rotor geometry, and position of rotor center of gravity is examined. P.T.H.

A75-22316 # Torsion of conical thin-walled aircraft structures. II (Kruchenie konicheskikh tonkostennykh aviakonstruktsii. II). Iu. V. Vasil'ev and O. I. Khurdubetsiu. *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 19, no. 2, 1974, p. 297-322. In Russian.

A method is proposed for calculating the torsional stress states in a thin-walled, conical aircraft structure of the fuselage type. Single-section and multisection structures are examined, and expressions are derived for determining the primary stresses counterbalancing the applied load and the secondary self-equilibrating stresses arising from the containment of warping of transverse sections for various boundary conditions. Computer implementation of the method is described, and some numerical examples are given. P.T.H.

A75-22324 Developers face 1975 CFM56 decision. M. L. Yaffee. *Aviation Week and Space Technology*, vol. 102, Feb. 24, 1975, p. 41-45.

The CFM56 engine now in the engineering development stage is a high-bypass-ratio turbofan engine designed to exceed 22,000 lb thrust at sea level on an 86 F day and to exceed a specific fuel consumption of 0.376 lb/hr/lb. Test engines have achieved these goals. The primary potential of the CFM56 is on derivatives of present short-, medium-, and long-range aircraft such as the DC-9, the B-737, the B-727, the HS.121 Trident, the B-707, and the DC-8. Applications on military tankers and transports, as well as commercial aircraft, are possible. Tests indicate that the CFM56 will be able to meet noise standards set for 1979, but the emission of nitrogen oxides and carbon monoxide presently exceed EPA limits. Sector burning is the only combustor concept which shows promise of decreasing these levels. Short-duct, confluent-flow, and mixed-flow installation configurations are under study. A.T.S.

A75-22325 Dash 7 designed to cut noise, pollution. W. C. Wetmore. *Aviation Week and Space Technology*, vol. 102, Feb. 24, 1975, p. 47-49, 51, 52.

A general description, comprising the airframe, control systems, engines, flight performance, and passenger and cargo arrangements, is given of the DHC-7 short-takeoff-and-landing (STOL) transport, which is powered by four turboprop engines. The design provides for major reductions in chemical pollution and noise. The engines will emit 0.6 lb of pollutants per passenger on a 200-mile flight carrying 50 passengers. Due to the STOL patterns and the engine configuration, the landing and takeoff noise footprint for the DHC-7 is calculated to be about 2.9% of that for the L-1011. A.T.S.

A75-22355 Decibels and noise indices: Several methods of evaluating sound levels, discomfort and annoyance due to noise from physical measurements (Décibels et indices de bruit: Diverses méthodes d'évaluation des niveaux sonores, gêne et nuisance dues au bruit à partir de mesures physiques). P. Liénard. Paris, Massonet Cie., Editeurs, 1974. 55 p. 55 refs. In French. \$6.50.

Different available means of evaluating high sound levels and their concomitant induction of discomfort and annoyance in listeners are discussed with the aim of providing a basis for a choice among these means. Computer comparisons are absolutely necessary due to the complexity of the calculations. The physical measuring techniques are presented, as well as 'subjective' measurements. The influence of the duration of the noises and of the intervals of silence between them is analyzed. Different discomfort indices are devised and compared. S.J.M.

A75-22356 On the expansion of a supersonic jet in the atmosphere (Sur l'expansion d'un jet supersonique dans l'atmosphère). C. Jacob (Bucuresti, Universitatea, Bucharest, Rumania). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques*, vol. 280, no. 3, Jan. 20, 1975, p. 153-156. In French.

The problem of a supersonic jet expanding in a stagnant atmosphere, previously treated by Prandtl, is taken up again. The jet exits from a nozzle with parallel walls; speed and pressure at the nozzle exit are assumed constant. The gas pressure at the exit is supposed greater than the atmospheric pressure. New formulas giving the length, maximum cross-section, and mean cross-section of the first expansion wave are established. S.J.M.

A75-22362 * Judgments of aircraft noise in a traffic noise background. C. A. Powell (NASA, Langley Research Center, Hampton, Va.) and C. G. Rice (Southampton, University, Southampton, England). *Journal of Sound and Vibration*, vol. 38, Jan. 8, 1975, p. 39-50. 9 refs.

An investigation was conducted to determine subjective response to aircraft noise in different road traffic backgrounds. In addition, two laboratory techniques for presenting the aircraft noise with the background noise were evaluated. For one technique, the background noise was continuous over an entire test session; for the other, the background noise level was changed with each aircraft noise during a session. Subjective response to aircraft noise was found to decrease with increasing background noise level, for a range of typical indoor noise levels. Subjective response was found to be highly correlated with the Noise Pollution Level (NPL) measurement scale. (Author)

A75-22363 Supersonic jet noise generated by large scale disturbances. C. K. W. Tam (Florida State University, Tallahassee, Fla.). *Journal of Sound and Vibration*, vol. 38, Jan. 8, 1975, p. 51-79. 26 refs. NSF Grant No. GK-35790.

A body of experimental evidence is now available which tends to suggest that the dominant part of supersonic jet noise is produced

by large scale flow disturbances. A mathematical model of large scale disturbances in a supersonic jet is presented in this paper. It is believed that the presence of large scale disturbances not only enhances the unsteady entrainment of ambient gas into the jet flow but also causes the jet to vibrate laterally. These unsteady processes in turn induce the emission of acoustic waves from the jet. Numerical calculations of the far field noise directivity pattern of a 2.2 Mach number cold jet according to the proposed model compare favorably with experimental measurements. (Author)

A75-22364 Self-excitation of an acoustic resonance by vortex shedding. F. S. Archibald (Cambridge University, Cambridge, England). *Journal of Sound and Vibration*, vol. 38, Jan. 8, 1975, p. 81-103. 10 refs. Research supported by the Ministry of Defence (Procurement Executive).

The vortex excited beta mode has been studied by using a low-speed wind tunnel with two loudspeakers attached by horns to opposite sides of the test section. By using the applied sound field it was possible to lock the vortex shedding from a bluff flat plate and shift the Strouhal number by 20%. The shift in Strouhal number caused the vortex shedding pressure on the flat plate surface near the trailing edge to vary in magnitude and phase with the reference acoustic field. At constant Strouhal number, the magnitude of the vector shedding was shown to depend upon the acoustic magnitude and trailing edge geometry. The phase did not change with acoustic mode magnitude, but the phase at any selected Strouhal number increased as the geometry was varied from convex to concave. Flow visualization pictures of the wake formation region are presented which show this phase variation and also the distinct large and fine scale wake structure at these high Reynolds numbers. A linear feedback model is developed which accounts for many of the properties of this self-exciting system. (Author)

A75-22368 Reduction of interaction tones from axial flow fans by non-uniform distribution of the stator vanes. P. E. Duncan and B. Dawson (Central London, Polytechnic, London, England). *Journal of Sound and Vibration*, vol. 38, Feb. 8, 1975, p. 357-371. 6 refs.

A theoretical model is presented for investigating the acoustic radiation resulting from the fluctuating forces at a downstream stator row which has nonuniformly circumferentially spaced stator vanes. It is found that, under certain circumstances, judicious uneven distribution of the stator vanes can be of significant acoustic benefit for medium speed fans. However, the deviations from uniform spacing required are quite considerable, and in order to avoid the associated aerodynamic problems a technique for simulating the desired configuration while leaving the vanes sensibly distributed around the annulus is developed. Experimental results obtained from a modified production fan are presented, and there is a significant degree of agreement between the experimental results and the predictions of the theory. This indicates that the technique may be used with some confidence in the design of inherently quiet turbomachinery. (Author)

A75-22370 The laminar boundary layer instability excitation of an acoustic resonance. F. S. Archibald (Cambridge University, Cambridge, England). *Journal of Sound and Vibration*, vol. 38, Feb. 8, 1975, p. 387-402. 14 refs. Research supported by the Ministry of Technology and Ministry of Defence.

Tollmien-Schlichting waves on a 10C4 airfoil spanning the working section of a low speed wind tunnel have been discovered as the source of excitation of the Parker beta-mode resonance. The feedback loop of the self-excited resonance is completed by acoustic coupling to the origin of the instability at the critical Reynolds number and occurs within the inner region of this laminar boundary layer instability. The coupling frequency range and amplification rate are predictable from instability theory. In the self-exciting system the sound enables the boundary layer to remain attached and laminar to the trailing edge which is far past the mid-chord separation point

calculated by using Thwaites' method. In this case the unsteady Kutta condition does not hold to the order of the instability pressure fluctuations in the boundary layer. (Author)

A75-22413 Personality aspects of involvement in pilot-error accidents. M. G. Sanders and M. A. Hoffman (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.). *Aviation, Space, and Environmental Medicine*, vol. 46, Feb. 1975, p. 186-190. 14 refs. Army-supported research.

The consistently high frequency of pilot-error accidents in both military and civilian aviation programs does much to support exploratory research which might help alleviate the problem. Cattell's Sixteen Personality Factor Questionnaire (16 PF), the Mehrabian Achievement Scale, and a dynamic decision making task (under risk) were given to 51 Army aviators. Accidents files were then examined in order to classify the aviators as to their prior pilot-error accident involvement. Stepwise discriminant analyses revealed that the decision-making task scores and the achievement scores were unrelated to the pilot error accident groupings while the 16 PF scores were able to correctly classify 86% of the aviators as to whether or not they had been previously listed as a cause factor in a military aviation accident. (Author)

A75-22489 # A near-optimal takeoff policy for heavily loaded helicopters exiting a confined area. F. H. Schmitz and C. R. Vause (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-261*. 9 p. 5 refs.

By application of optimal control theory to an experimentally verified dynamic mathematical performance model, a simple, near-optimal takeoff control technique has been developed for heavily loaded helicopters operating from a confined area. This paper places primary emphasis on understanding the physical tradeoffs and implications involved. Two significant results are presented, (1) a two-segment, near-optimal takeoff control technique for heavily loaded helicopters exiting from a confined area, and (2) a means of estimating, from hover performance, the distance required to clear an obstacle in the departure path. (Author)

A75-22490 # Military aircraft maintenance - A new concept. T. D. Matteson (United Air Lines, Inc., San Francisco, Calif.) and R. A. Barnard (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-262*. 7 p.

A substantial maturing of maintenance philosophy has occurred in the air transportation industry with introduction of the modern large wide-body airplanes. Application of that new philosophy in a military environment is both feasible and practical. With due consideration of the large and growing expenditures required for aircraft maintenance, and a desire to reverse unfavorable cost trends, the U.S. Navy has formed a team to design, develop, and implement advanced maintenance plans for two first-line weapon systems. New maintenance plans have been developed and are now being implemented. Early results indicate substantially reduced maintenance cost, better-operating airplanes, and significant improvement in aircraft availability. (Author)

A75-22491 # Trends in vehicle computer systems. E. Levin (System Development Corp., Colorado Springs, Colo.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-267*. 5 p.

Increasing utilization of digital computers in vehicle systems is attributed to a confluence of functional requirements for speed, accuracy and safety coupled with hardware technology advances resulting in acceptable characteristics of weight, power, size, cost and reliability. The trends to date have been established by aerospace vehicles where computers have been used for control, information processing, data recording, monitoring and display. Unique features include nonrecurring software costs, inability to predict all operational scenarios and potentially severe consequences resulting from computer system errors. As the use of computers for surface vehicle systems expands, aerospace experiences can be used to avoid pitfalls. (Author)

A75-22493 # **Crashworthiness engineering of automobiles and aircraft - Progress and promise.** R. J. Melosh (MARC Analysis Research Corp., Palo Alto, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-270.* 12 p. 107 refs.

This paper reviews progress made in improving the technological resources of crashworthiness engineering: physical testing developments, analytical simulation techniques and inventions and design tools. It defines some of the unresolved problems associated with development of design tools by discussing modeling of structures and exteriors. It concludes that physical test technology is well advanced for highway vehicles and particularly that available mathematical models, principally for structures and bioengineering, are of limited value because of inadequate work in assuring numerical modeling fidelity and strengthening test-analysis correlation; and that significant improvements in crashworthiness of in-use vehicles awaits more design tools. (Author)

A75-22494 * # **Simulation of aircraft crash and its validation.** R. J. Hayduk and R. G. Thomson (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-271.* 10 p. 6 refs.

NASA Langley Research Center is engaged in an extensive research and development task aimed at providing the general aviation industry with reliable crashworthy airframe design technology. This paper describes the full-scale crash tests of general aviation airplanes being conducted to generate data on simulated crashes and to study the nonlinear dynamic behavior of aircraft structures. Analytical techniques under development for predicting nonlinear behavior of general airframe structures under crash-loading conditions are also described. Data are presented from the full-scale crash tests as well as comparison of analytical predictions with experimental results on some simplified structures. (Author)

A75-22496 * # **Advanced short haul systems in high density markets.** T. L. Galloway (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-274.* 11 p. 17 refs.

The design requirements, performance, economics, and noise aspects of STOL and VTOL conceptual aircraft developed for short haul air transportation are reviewed, along with the characteristics of areas of high-density annual passenger flow in which the aircraft are intended to operate. It is shown that aircraft of 100 to 200 passenger capacity provide the best return on investment in high density markets. The various STOL propulsive lift concepts have the same general trends with field length; their wing loadings are 20 to 30 pounds per square foot higher than the nonpropulsive lift concepts. A comparison of the aircraft under consideration shows that no one aircraft concept will be optimum for all future operational environments. V.P.

A75-22497 * # **Rotary-wing aircraft systems for the short-haul market.** J. P. Magee, R. D. Clark (Boeing Vertol Co., Philadelphia, Pa.), and D. Giulianetti (NASA, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-275.* 10 p. 6 refs. Contract No. NAS2-8048.

This paper describes preliminary designs of tilt-rotor and tandem-rotor helicopter V/STOL aircraft for the 1958 short-haul market. These designs include a tilt-rotor aircraft designed for STOL-only operation. The baseline designs are presented with technological and cost data. The impact of noise and ride qualities on aircraft size and cost, and on passenger acceptance are discussed. The results of the study are compared against competitive alternatives in air transportation. (Author)

A75-22498 * # **Advanced concept considerations for STOL short-haul systems.** H. S. Sweet and J. H. Renshaw (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-276.* 10 p. 13 refs. Contract No. NAS2-6995.

Design, performance, and economic tradeoffs for STOL short-haul systems are presented. The analyses showed that quiet, short-field aircraft can be economically viable and provide benefits to airport congestion and to community noise relief. The objective of the studies was to compare and evaluate propulsive-lift systems and low-wing-loading aircraft provided with ride quality control and gust load alleviation, and to determine fuel consumption and cost tradeoffs, along with recommendations for development of technology, noise criteria, and airport planning. In the low density arena, the optimum aircraft sized for less than 50 passengers have active controls for ride quality and gust alleviation; turboprop propulsion offers significant cost and fuel saving with no appreciable block time penalty for the short typical stage lengths (on the order of 150 miles). In the high density arena, high bypass-ratio fan-powered aircraft, with design cruise speed of 0.7 to 0.75M and range capability to 1500 miles, are considered to be optimum. Field performance of 3000 feet or better can be achieved by the hybrid over-the-wing/internally blown flap concept with viable economics and low fuel consumption. Mechanical flap aircraft with high bypass-ratio engines are indicated to be superior for field lengths of 3500 feet or more. Technology development of propulsive lift is required, and further definition of the best fan-powered engine for low noise and low fuel consumption is needed. (Author)

A75-22499 # **The lift/cruise fan multimission V/STOL aircraft.** L. R. Novak (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-277.* 12 p.

Future aircraft must have multimission, multirole capability to avoid proliferation of types and conform to apparent economic trends. A specific lift/cruise fan aircraft capable of providing realistic multimission, multirole potential comprises highly integrated systems carefully blended with the aerodynamic configuration. The aircraft appeal stems from high performance and inherent operational qualities characteristic of fixed-wing turbofan aircraft. Reasons are given why turboprop fans were selected over mechanically driven fans. The maturity of the selected system is supported by technology developments in key areas of propulsion, energy transfer and control, lift/cruise thrust vectoring, induced lift, downwash flow field and wind tunnel testing. (Author)

A75-22505 # **The current status of general aviation technology.** S. J. Green (General Aviation Manufacturers Association, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-289.* 6 p.

Examples are given of current technology developed in the general aviation industry for avionics system integration and icing tests. Aspects of the technology involved in airframe construction and structural substantiation and in aerodynamic testing are discussed. Major efforts are being made to diminish the noise (including interior noise) and chemical pollutants produced by aircraft in general aviation. A.T.S.

A75-22506 # Opportunities for progress in general aviation technology. J. Roskam (Kansas, University, Lawrence, Kan.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-292.* 16 p. 33 refs.

A number of design parameters and design features of general aviation airplanes are examined from a viewpoint of making substantial improvements. It is shown that the potential for major improvements exists in areas such as controls, aerodynamics, structures, propulsion, noise, avionics, and operations. By rationally combining a number of such technological improvements, it is shown that major improvements in general aviation airplane performance are possible. Far from being a stagnating field of technology, it appears that general aviation technology is headed for a decade of exciting new developments. (Author)

A75-22508 * # Conceptual design of reduced energy transports. M. D. Ardema, M. Harper, C. L. Smith, M. H. Waters, and L. J. Williams (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-303.* 8 p. 6 refs.

This paper reports the results of a conceptual design study of new, near-term fuel-conservative aircraft. A parametric study was made to determine the effects of cruise Mach number and fuel cost on the 'optimum' configuration characteristics and on economic performance. Supercritical wing technology and advanced engine cycles were assumed. For each design, the wing geometry was optimized to give maximum return on investment at a particular fuel cost. Based on the results of the parametric study, a reduced energy configuration was selected. Compared with existing transport designs, the reduced energy design has a higher aspect ratio wing with lower sweep, and cruises at a lower Mach number. It yields about 30% more seat-miles/gal than current wide-body aircraft. At the higher fuel costs anticipated in the future, the reduced energy design has about the same economic performance as existing designs. (Author)

A75-22509 # Design concepts for future cargo aircraft. R. H. Lange (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-306.* 12 p. 15 refs.

The design of cargo aircraft for the future is influenced by an ever-increasing number of performance, operational, environmental, and economic requirements. Ingenuity in design concepts and application of advances in technology are required to derive efficient cargo aircraft compatible with these apparently conflicting requirements. This paper presents results of preliminary design studies of advanced technology cargo aircraft including novel distributed-payload Spanloader designs, hydrogen-fueled transports, nuclear-powered transports, and ram-wing vehicles. The data cover airplane gross weights up to approximately 2 million pounds and payloads up to 900,000 pounds. (Author)

A75-22510 # SST-HST profitability domain in the era of high petroleum costs. H. E. Roland (Southern California, University, Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-307.* 7 p. 9 refs.

In view of recent speculation regarding the relationship of the hypersonic transport (HST) to the supersonic transport (SST), it would seem useful to examine the competitive interaction of these two advanced commercial flight systems, with a model capable of parameterizing many of the pertinent technical and economic descriptors. The present paper addresses this interaction with a model which utilizes profitability as the primary decision variable. The two principal aircraft interact in a 'most likely' company of six subsonic aircraft types. A passenger and cargo demand are served on a typical route structure of 100 nondirectional routes at a demand level of the year 2000. Petroleum and hydrogen fuel costs, SST and HST fare increments, and load factor, are parameterized as possible aircraft fleet mixes compete to serve the demand. The HST becomes a dominant system at petroleum fuel escalation of three per cent per annum and liquid hydrogen cost of ten cents per pound with fare premiums for the SST and HST of 1.2 and 1.44, respectively. (Author)

A75-22513 # Energy efficiency of current intercity passenger transportation modes. M. P. Miller and G. J. Schott (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-314.* 11 p. 26 refs.

A detailed study was conducted to compare three public modes (aircraft, train, and bus) and one private mode (automobile). The comparison represented Spring 1974 conditions and was conducted in two parts. The first one collected or developed basic energy efficiency data for each mode. In the second one this data was applied to passenger transportation between 10 city pairs. These results were extended using national system trends to obtain a comparison for the total city pair population. The paper presents results from the study and emphasizes the importance of establishing clear groundrules to ensure fair comparisons through consistent data. Many earlier papers show deficiencies in this respect. Some of these deficiencies will be specifically pointed out in order to explain why this paper's results differ from those of previous papers. (Author)

A75-22514 * # Future long-range transports - Prospects for improved fuel efficiency. A. L. Nagel, W. J. Alford, Jr. (NASA, Langley Research Center, Hampton, Va.), and J. F. Dugan, Jr. (NASA, Lewis Research Center, Wind Tunnel and Flight Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-316.* 18 p. 52 refs.

A status report is provided on current thinking concerning potential improvements in fuel efficiency and possible alternate fuels. Topics reviewed are: historical trends in airplane efficiency; technological opportunities including supercritical aerodynamics, vortex diffusers, composite materials, propulsion systems, active controls, and terminal-area operations; unconventional design concepts, and hydrogen-fueled airplane. (Author)

A75-22515 * # Air transportation energy consumption - Yesterday, today, and tomorrow. A. C. Mascy and L. J. Williams (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-319.* 9 p. 29 refs.

The energy consumption by aviation is reviewed and projections of its growth are discussed. Forecasts of domestic passenger demand are presented, and the effect of restricted fuel supply and increased fuel prices is considered. The most promising sources for aircraft fuels, their availability and cost, and possible alternative fuels are reviewed. The energy consumption by various air and surface transportation modes is identified and compared on typical portal-

to-portal trips. A measure of the indirect energy consumed by ground and air modes is defined. Historical trends in aircraft energy intensities are presented and the potential fuel savings with new technologies are discussed. (Author)

A75-22517 # Testing for design - F-15 powerplant integration. J. F. Mello (McDonnell Aircraft Co., Aerodynamics Dept., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-328.* 7 p.

The F-15 Eagle represents the successful integration of a high thrust powerplant (two P&WA F-100 engines) in a highly maneuverable fighter aircraft. The design effort relied heavily on wind tunnel test data because the complex flow fields involved are not amenable to analytical evaluation. This paper discusses the testing techniques used and the knowledge gained in an extensive wind tunnel test program. The wind tunnel test program not only provided configuration refinements for improved performance but also minimized expensive flight development testing. (Author)

A75-22518 # Cost effective use of flight simulation. P. A. Reynolds (Calspan Corp., Buffalo, N.Y.), F. A. Wirth (American Airlines Training Center, Fort Worth, Tex.), and R. H. Mathews (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D.C., Feb. 24-26, 1975, Paper 75-329.* 13 p. 19 refs.

Greater use of flight simulation is saving money in today's difficult financial climate. However, a wide variety of equipment and techniques exist and careful decisions can enhance simulation cost effectiveness. The design, training, and research and development uses of simulation are considered with examples taken from fighter design, airline and military training, space shuttle development, and other case histories. The most recent developments in simulation state of the art are described and the comparative cost of simulation and flight of the actual airplane is considered. The important question is what simulation gives the most confidence for the least money, but in many areas basic knowledge is insufficient to produce answers. (Author)

A75-22521 Polyimides for fiber composites. L. E. Lorenson (California, University, Livermore, Calif.). *SAMPE Quarterly*, vol. 6, Jan. 1975, p. 1-13. 40 refs. AEC-Navy-supported research.

Because of their advantages in processability and availability of starting materials as compared with other high-temperature polymers, polyimides have gained prominence among commercially available extreme-service polymers. Available polyimides were surveyed for use in a fiber composite system for large-shaped aircraft parts at relatively high temperature service conditions. The polyimide production processes are described, then the properties of seven polyimides are examined in detail. Since there is no single, universally applicable polyimide-producing system at this time, matching of material to requirements is necessary. Comprehensive tables listing detailed information about the seven polyimides are included. F.G.M.

A75-22565 # The real-world, 'stressed' environment of air-traffic control. G. B. Litchford. *Astronautics and Aeronautics*, vol. 13, Mar. 1975, p. 41-43.

Consideration is given to several aspects of air-traffic control systems and comments are made concerning opinions expressed earlier by G. A. Pakholkov (1975). The importance of international acceptance of uniform ICAO standards is emphasized. The present ICAO SSR (secondary surveillance radar) system is judged to have ample code capacity. The use of both the Ku and C bands for microwave landing systems (MLS) is discussed. A.T.S.

A75-22727 Fundamentals of calculating aircraft structures (Elements pour le calcul des structures d'avions). J. M. Fehrenbach. Toulouse, Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, 1974. 102 p. In French.

Calculation of the breaking strength of several aircraft structural parts is studied. The study is limited to structures constructed from thin reinforced metal sheet. General concepts and principles concerning aircraft parts and their strength are presented. Methods of testing the resistance of a structure to buckling are described. Design of the break-resistant parts of a wing is treated in detail. Calculation of the rudder and fuselage conclude the work. S.J.M.

A75-22747 # Minimum performance standards - Airborne ground proximity warning system. Washington, D.C., Radio Technical Commission for Aeronautics (Document No. DO-161), 1975. 31 p. \$8.00.

Ground Proximity Warning equipment is intended as an aid to warn aircrews of imminent inadvertent contact with the ground due to excessive rates of descent, excessive closure rate to terrain, negative climb rate after take-off and flight into terrain when not in landing configuration. Primary performance tests are specified for temperature, altitude, humidity, shock, vibration, temperature variation, power input, conducted voltage transience, audio-frequency conducted susceptibility, audio-frequency magnetic susceptibility, and radio frequency susceptibility. Secondary and optimal tests for a variety of other conditions are also specified. Appendices provide graphs for warning conditions and describe test procedures and equipment. F.G.M.

A75-22748 The use of higher-order surface singularity distributions to obtain improved potential flow solutions for two-dimensional lifting airfoils. J. L. Hess (Douglas Aircraft Co., Long Beach, Calif.). *Computer Methods in Applied Mechanics and Engineering*, vol. 5, Jan. 1975, p. 11-35. 7 refs. Research sponsored by the Douglas Aircraft Independent Research and Development Program.

This paper analyzes and tests the ability of the surface source singularity method to calculate flow about two-dimensional lifting airfoils using the relatively small element numbers typical of three-dimensional cases. The aim is to discover improved calculation techniques for both two and three dimensions. The body of the paper presents a series of test airfoils about which the flow has been calculated by various refinements of the method. Conclusions are drawn from the results. The original form of the method, which uses flat surface elements, piecewise constant source density, and a constant surface vorticity distribution, is found to be satisfactory for 'ordinary' simple airfoils with finite trailing edges. For airfoils with very thin and/or highly loaded aft portions, the original form of the method experiences difficulty, generally due to the fact that a singularity of the source density is required at the trailing edge. By using a parabolic surface vorticity the difficulty is largely alleviated, and satisfactory results are obtained. This modification is very easy to implement numerically. (Author)

A75-22784 Problems and challenges - A path to the future. J. E. Steiner (Boeing Commercial Airplane Co., Renton, Wash.). *Aeronautical Journal*, vol. 79, Jan. 1975, p. 1-14.

In 1968 the Boeing Company was faced with a sharp drop in commercial sales and a severe economic crisis. To deal with this crisis, company size had to be decreased while efficiency and sales had to be increased. The first goal was successfully accomplished by manpower reductions at all levels, organizational consolidation, sale of facilities and overhaul of basic business systems. Efficiency was increased as a result of these measures. Sales were increased by improving product lines, and their performance, developing FAR 36 compliance noise configurations and expanding foreign markets. By 1974 production rose and stabilized, while most skilled workers were

rehired. Although the current economic situation will yet have an impact on the aircraft industry, the airliner market is ever increasing and more efficiency in production is being achieved. F.G.M.

A75-22786 **QSTOL aircraft.** J. D. Haley. *Aeronautical Journal*, vol. 79, Jan. 1975, p. 34-37.

Quiet Short Take-off and Landing aircraft would produce no more than 90 perceived noise decibels over an area of 0.9 sq miles, of length 4 miles, compared with an area of 16 sq miles, length 14 miles, for relatively quiet conventional aircraft already in service. One study regarding QSTOL aircraft uses the leading edge slot, triple slotted flap configuration powered by such high bypass ratio engines as the Rolls-Royce RB211 and Snecma M45H. A high bypass ratio engine reduces jet roar and eliminates the high pitched whine associated with high fan speeds. While such engines produce good take-off and climb performance, they have no effect on reducing landing approach speeds. Theoretical aerodynamic solutions to this problem are suggested along with various schemes for high performance STOL vehicles. F.G.M.

STAR ENTRIES

N75-15602* National Aeronautics and Space Administration, Washington, D.C.

NASA AERONAUTICS

[1974] 12 p Original contains color illustrations
(NF-46/5-74) Avail: SOD HC \$0.50 CSCL 01B

A fact sheet depicting the NASA programs involving aircraft development and aeronautics is presented. The fact sheet consists of artist concepts of the various aircraft which represent specific programs. Among the subjects discussed in the concise explanatory notes are: (1) the YF-12 aircraft, (2) hypersonic drag tests in wind tunnels, (3) augmentor wing concepts, (4) rotary wing development, (5) fly-by-wire aircraft control, (6) supercritical wings, (7) the quiet engine program for noise and emission abatement, (8) flight capabilities of lifting bodies, (9) tilt rotor concepts for improved helicopter performance, and (10) flight safety improvements for general aviation aircraft. P.N.F.

N75-15605* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTAL MEASUREMENTS OF SKIN FRICTION ON UPPER SURFACE BLOWN WING

Dennis D. Miner and James F. Campbell 3 Jan. 1975 39 p refs

(NASA-TM-X-72634) Avail: NTIS HC \$3.75 CSCL 01A

An experimental investigation was conducted to obtain skin-friction measurements on a wing with a circular jet exhausting above it. A Preston tube was used to determine the local shear stress at a point on the wing's upper surface. Data were obtained for four nozzle pressures and four vertical displacements of the jet above the wing. The results indicated that the highest skin-friction values occurred with the jet closest to the wing and with the highest nozzle pressure. These data trends were validated by calculations which combined two-dimensional, turbulent boundary-layer theory with axisymmetric co-flowing jet theory. Author

N75-15606* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTAL AND THEORETICAL LOW SPEED AERODYNAMIC CHARACTERISTICS OF THE NACA 65 SUB 1-213, ALPHA EQUALS 0.50, AIRFOIL

William D. Beasley and Robert J. McGhee Washington Feb. 1975 74 p refs

(NASA-TM-X-3160; L-9773) Avail: NTIS HC \$4.25 CSCL 01A

Low-speed wind-tunnel tests have been conducted to determine the two-dimensional aerodynamic characteristics of the NACA 65 sub 1-213, $\alpha = 0.05$, airfoil. The results were compared with data from another low-speed wind tunnel and also with theoretical predictions obtained by using a viscous subsonic method. The tests were conducted over a Mach number range from 0.10 to 0.36. Reynolds numbers based on the airfoil chord varied from about 3 million to 23 million. Author

N75-15607* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

AN ANALYTICAL EVALUATION OF AIRFOIL SECTIONS FOR HELICOPTER ROTOR APPLICATIONS

Gene J. Bingham Washington Feb. 1975 24 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

(NASA-TN-D-7796; L-9710) Avail: NTIS HC \$3.25 CSCL 01A

An analytical technique was used to evaluate airfoils for helicopter rotor application. This technique permits assessment of the influences of airfoil geometric variations on drag divergence Mach number at lift coefficients from near zero to near maximum lift. Analytical results presented in this paper indicate the compromises in drag divergence Mach number which result from changes in (1) thickness ratio, (2) location of maximum thickness, (3) leading-edge radius, (4) camber addition, and (5) location of maximum camber of NACA four- and five-digit-series airfoils and some 6-series airfoils of potential interest for helicopters. Examples of airfoil sections which combine several of the geometric changes favorable to both advancing and retreating section performance have been presented. Author

N75-15608* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

LOW-SPEED WIND-TUNNEL INVESTIGATION OF FORWARD-LOCATED SPOILERS AND TRAILING SPLINES AS TRAILING-VORTEX HAZARD-ALLEVATION DEVICES ON AN ASPECT-RATIO-8 WING MODEL

Delwin R. Croom Washington Feb. 1975 26 p refs
(NASA-TM-X-3166; L-9892) Avail: NTIS HC \$3.75 CSCL 01A

An investigation was made in the Langley V/STOL tunnel in order to determine, by the trailing-wing sensor technique, the effectiveness of either a forward-mounted spoiler or a tip-mounted spline as trailing-vortex attenuation devices on an unswept aspect-ratio-8 wing model. The trailing-wing rolling-moment data taken in the tunnel diffuser section show good agreement with the data taken in the tunnel test section. This agreement indicates that reasonable results may be obtained in the Langley V/STOL tunnel in experimental investigations of the trailing-vortex hazard at relatively great distances behind aircraft models. Author

N75-15610* Texas A&M Univ., College Station. Dept. of Aerospace Engineering.

DEVELOPMENT OF INVERSE INVISCID TRANSONIC SOLUTION METHODS Final Report, Nov. 1973 - Dec. 1974

Leland A. Carlson Dec. 1974 23 p refs

(Grant NGR-44-001-157)

(NASA-CR-142016; TAMRF-3033-7403) Avail: NTIS HC \$3.25 CSCL 01A

A numerical method suitable for the analysis and/or design of supercritical transonic airfoils is reported. In order to achieve accuracy, the method utilizes the full inviscid potential flow equations; and in order to remain simple it solves the problem in a stretched Cartesian grid system. The resulting computer program has several advantages over others of its type -- its use in either the direct analysis mode in which the airfoil shape is prescribed and the flow field and surface pressures are determined, or in the inverse mode in which the surface pressures are given and the airfoil shape and flow field are computed. Other advantages of the program include its use in a design program, the rotated finite difference scheme and its determination of the airfoil shape simultaneously with the flow field relaxation solution. Author

N75-15611* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

LOW SPEED AERODYNAMIC CHARACTERISTICS OF A LIFTING-BODY HYPERSONIC RESEARCH AIRCRAFT CONFIGURATION

Jim A. Penland Washington Feb. 1975 69 p refs

(NASA-TN-D-7851; L-9811) Avail: NTIS HC \$4.25 CSCL 01C

An experimental investigation of the low-speed longitudinal, lateral, and directional stability characteristics of a lifting-body hypersonic research airplane concept was conducted in a low-speed tunnel with a 12-foot (3.66-meter) octagonal test section at the Langley Research Center. The model was tested with two sets of horizontal and vertical tip controls having different planform areas, a center vertical tail and two sets of canard controls having trapezoidal and delta planforms, and retracted and deployed engine modules and canopy. This investigation was conducted at a dynamic pressure of 239.4 Pa (5 psf) (Mach number of 0.06) and a Reynolds number of 2 million based on the fuselage length. The tests were conducted through an angle-of-attack range of 0 deg to 30 deg and through horizontal tail deflections of 10 deg to minus 30 deg. The complete configuration exhibited excessive positive static longitudinal stability about the design center-of-gravity location. However, the configuration was unstable laterally at low angles of attack and unstable directionally throughout the angle-of-attack range. Longitudinal control was insufficient to trim at usable angles of attack. Experiments showed that a rearward shift of the center of gravity and the use of a center-located vertical tail would result in a stable and controllable vehicle. Author

N75-15612* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COLD AIR STUDY OF THE EFFECT ON TURBINE STATOR BLADE AERODYNAMIC PERFORMANCE OF COOLANT EJECTION FROM VARIOUS TRAILING EDGE SLOT GEOMETRIES. 2: COMPARISON OF EXPERIMENTAL AND ANALYTICAL RESULTS

Herman W. Prust, Jr. Washington Feb. 1975 27 p refs (NASA-TM-X-3190; E-8121) Avail: NTIS HC \$3.75 CSCL 20D

Experimentally determined efficiencies of turbine stator blades having trailing-edge coolant ejection are compared with efficiencies predicted from two previously published approximate analytical methods. The experimental results were obtained from two-dimensional data with the temperature of the primary and coolant flows both being nearly ambient. Data from five stator blade configurations having different slotted trailing-edge geometries were included in the comparison. The two analytical methods gave results which agreed reasonably well with experimental results. An average of the absolute values of differences between experimental and predicted efficiencies for all five blade configurations showed that one method gave average efficiency differences which were about 1.3 percent different than experimental efficiencies, while the other method gave average efficiency differences that were about 0.7 percent different than experimental. However, in some instances, maximum differences of as much as 4 percent occurred. A comparison between experimental and analytical results indicated that the ratio of trailing-edge slot width to trailing-edge thickness influences the measured efficiencies to a greater extent than is accounted for by either analytical model. Author

N75-15613* Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

CONDUCT OVERALL TEST OPERATIONS AND EVALUATE TWO DOPPLER SYSTEMS TO DETECT, TRACK AND MEASURE VELOCITIES IN AIRCRAFT WAKE VORTICES

Final Report
D. J. Wilson, M. C. Krause, C. E. Craven, B. B. Edwards, E. W. Coffey, C.-C. Huang, J. L. Jetton, and L. K. Morrison Dec. 1974 61 p

(Contract NAS8-30645)
(NASA-CR-120600; LMSC-HREC-TR-D390470) Avail: NTIS HC \$3.75 CSCL 01A

A program plan for system evaluation of the two-dimensional Scanning Laser Doppler System (SLDS) is presented. In order to meet system evaluation and optimization objectives the following tests were conducted: (1) noise tests; (2) wind tests; (3) blower flowfield tests; (4) single unit (1-D) flyby tests; and (5) dual unit (2-D) flyby tests. Test results are reported. The final phase of the program included logistics preparation, equipment interface checkouts, and data processing. It is

concluded that the SLDS is capable of accurately tracking aircraft wake vortices from small or large aircraft, and in any type of weather. J.M.S.

N75-15615# New York Univ., N.Y. AEC Computing and Applied Mathematics Center.

THREE DIMENSIONAL FLOWS AROUND AIRFOILS WITH SHOCKS

A. Jameson 1973 29 p refs Presented at IFIP Symp. on Computing Methods in Appl. Sci. and Eng., Paris, Dec. 1973 (Contract AT(11-1)-3077)
(COO-3077-43; Conf-731221-1) Avail: NTIS HC \$3.75

The determination of flows containing embedded shock waves over a wing in a stream moving at near sonic speed is considered on an isolated wing placed at an arbitrary yaw angle in a uniform free stream with prescribed Mach number at infinity. According to the Kutta condition the viscous effects cause the circulation at each span station to be such that the flow passes smoothly off the sharp trailing edge. The varying spanwise distribution of lift generates a vortex sheet that trails in the streamwise direction behind the trailing edge, and behind the side edge of the downstream tip. In practice the vortex sheet rolls up behind each tip and decays through viscous effects. A simplified model was used in which convection and decay of the sheet are ignored. At infinity the flow is undisturbed except in the Trefftz plane far downstream, where there will be a two dimensional flow induced by the vortex sheet. NSA

N75-15616# AeroVironment, Inc., Pasadena, Calif.

INFLUENCE OF METEOROLOGICAL FACTORS ON THE VORTEX WAKE OF A LIGHT TWIN-ENGINE AIRCRAFT **Final Report, 1 Jun. 1972 - 31 Jan. 1974**

Ivar Tombach 25 Mar. 1974 90 p refs
(Contract F44620-72-C-0088)
(AD-787853; AV-FR-416; AFOSR-74-1507TR) Avail: NTIS CSCL 01/1

The smoke-marked trailing vortex wake generated by a light, twin-engine aircraft (AeroCommander 560F) was probed by another instrumented aircraft and the velocity and temperature fields in the wake were measured. Ground-based cameras recorded overall wake motion and decay due to instabilities. It was determined that wakes descending in a stably stratified atmosphere acquire buoyancy and then subsequently begin to lose it before they break up. The speed of descent of the wakes decreases with time, and the vortex spacing and the size of the buoyant oval both increase very slightly as the wake descends. A clear correlation between wake tilting and wind shear has been established, and it was determined that shear is one factor which causes the sometimes-observed single persistent vortex. (Modified author abstract) GRA

N75-15617# Army Materiel Command, Texarkana, Tex. Intern Training Center.

DETERMINATION OF OPTIMAL USE LIFE OF US ARMY T-10 TROOP TYPE PERSONNEL PARACHUTES, PART 2 **Final Report**

Ronald S. Morris (Texas A and M Univ., Texarkana) and Don E. Ferrell Jun. 1974 31 p
(AD-787299; USAMC-ITC-02-08-73-001-Pt-2) Avail: NTIS CSCL 01/3

This report describes a procedure which, if employed, can provide the data on the properties of personnel parachute assemblies necessary for justification of an age life extension. In Part One of this report, several methods of data collection and analyses are introduced which are currently being employed by the various Services to investigate use and age life limitations of parachutes. Part One dealt primarily with a study, conducted in conjunction with the U.S. Army Natick Laboratories, seeking to justify a use life extension of U.S. Army T-10 troop-type main personnel parachutes. This report details an experimental design which should be used to provide the necessary statistical basis for establishing the degree of an age life extension as recommended in Part One. GRA

N75-15618# Lockheed-Georgia Co., Marietta. Flight Sciences Div.

WAKE EFFECT STUDIES ON A TWO DIMENSIONAL TRAILING EDGE HIGH LIFT SYSTEM Final Report, 22 Jan. 1973 - 22 Apr. 1974

22 Apr. 1974 216 p refs

(Contract N00019-73-C-0239)

(AD-787141) Avail: NTIS CSCL 20/4

Experimental investigations were performed on a two component airfoil for studying the effects of the wake of the forward element on the development of the viscous flow on the upper surface of the flap. Measurements of the initial conditions, the boundary layer on the upper surface of the flap, and pressure distributions on the airfoil surfaces were obtained both in the presence and absence of the wake of the forward element. The nature of the viscous flow on the flap has been examined at angles of attack up to maximum lift coefficient conditions. Correlative analysis was performed to establish the validity and limits of applicability of the present boundary layer methods, confluent boundary layer method, and multi-component airfoil program for the prediction of the aerodynamic performance characteristics. (Modified author abstract) GRA

N75-15619# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.

RESEARCH ON AEROELASTIC PHENOMENA IN AIRFOIL CASCADES: SUPERSONIC INLET TORSIONAL FLUTTER

Sanford Fleeter, Robert B. McClure, George T. Sinnet, and Robert L. Holtman Sep. 1974 49 p refs

(Contract N00014-72-C-0351; NR Proj. 094-369)

(AD-787088; DDA-EDR-8297) Avail: NTIS CSCL 20/4

The paper describes a unique supersonic inlet with a subsonic axial component, torsional flutter cascade experiment, wherein a computer controlled electromagnetic airfoil excitation system is used to simulate the fundamental time-dependent airfoil interaction; assure periodicity; and control the interblade phasing angle. Experimental data are presented which indicate the variation and significance of the cascade inlet Mach number, the stagger angle, and the interblade phasing angle on the cascade dynamic torsional aeroelastic characteristics. Author (GRA)

N75-15620# Army Aviation Systems Test Activity, Edwards AFB, Calif.

ROTOR FLOW SURVEY PROGRAM UH-1M HELICOPTER Final Report

Barclay H. Boirun, Robert P. Jefferis, and Ronald S. Holasek May 1974 73 p refs

(DA Proj. 1M2-62303-A-214)

(AD-787428; USAASTA-72-05) Avail: NTIS CSCL 01/1

Tests were conducted to determine the rotor wake boundaries and to measure the instantaneous airflow in a test volume adjacent to a UH-1M helicopter under actual flight conditions. The primary test volume of interest was a 4 by 5 by 6-foot box forward of the weapons- mount location. Airflow data were measured by a rake containing 7 split-film total vector anemometers during steady forward airspeeds ranging from hover to 90 knots true airspeed. Flight testing was terminated after one productive flight because of failure of the anemometer instrumentation. However, the data obtained prior to the sensor failure appeared to be of good quality and are presented for analysis. A second test on an AH-1G helicopter is planned, when a correction for the sensor failures is determined. The UH-1M airflow testing was conducted during April and June 1973. Author (GRA)

N75-15621# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A COMPARISON OF APPROXIMATE METHODS OF PREDICTING SHOCK DETACHMENT DISTANCE FOR TWO-DIMENSIONAL SUPERSONIC INLETS M.S. Thesis

Harry E. Schulte Sep. 1974 59 p refs

(AD-787695; GAE/AE/74S-6) Avail: NTIS CSCL 20/4

The objective of this study is to compare approximate techniques for predicting shock detachment distance in two-dimensional supersonic inlets. The motivation for such a comparison arises from the need to determine more accurately

the ramp pressure contribution to supersonic additive drag. Four methods for estimating bow shock position are presented and compared with experimental data from a 20% model of the B-1 external compression supersonic inlet. Static pressure data taken on the third ramp of the B-1 inlet model yield an effective bow shock position with which to compare the prediction procedures. (Modified author abstract) GRA

N75-15622# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.

AERODYNAMIC ANALYSIS OF A PROFILE FIGHTER TOW TARGET

J. B. Smith 22 Oct. 1974 15 p refs

(AD-787639; NADC-74143-30) Avail: NTIS CSCL 01/3

This report presents the aerodynamic characteristics of a proposed aerial tow target configured to meet the requirements of the Navy Standard Tow Target System for a large gunnery target. The Profile Fighter Tow Target will be both size and performance representative of potential enemy fighter airplanes. Author (GRA)

N75-15623# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN EXAMINATION OF THE RATE VARIANCE FORMULA FOR THE A-10 AIR VEHICLE M.S. Thesis

John J. Gaunt, Jr. Sep. 1974 111 p refs

(AD-787705; GSM/SM/74S-8) Avail: NTIS CSCL 01C

The first two lots of production model A-10 close air support aircraft are being purchased under variable lot options. These options allow for the quantity to vary plus or minus 50% from the nominal, or base-line quantities. Baseline prices were established and Rate Variance Formulas (RVF) govern the prices for the other quantities. The Fairchild Republic RVF covers the Air Vehicle. An examination was made of each element within this RVF. The examination included the development and treatment of the costs within each cost element. Comparisons were made with cost estimating relationships developed from previous research, existing theory regarding the manner in which costs vary with changes in quantity and generally accepted principles and practices. Where the available information was inconclusive, sensitivity analysis was performed. (Modified author abstract) GRA

N75-15624# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

TAKEOFF AND LANDING ANALYSIS (TOLA) COMPUTER PROGRAM. PART 2: PROBLEM FORMULATION

Urban H. D. Lynch and John J. Dueweke May 1974 270 p refs

(AF Proj. 1431)

(AD-787656; AFFDL-TR-71-155-Pt-2) Avail: NTIS CSCL 01/2

A well-defined integration of the various aspects of the aircraft takeoff and landing problem is presented in the form of a generalized computer program. Total aircraft system performance is evaluated during the glide slope, flare, landing roll, and takeoff. The flight dynamics of a generalized, rigid body, aerospace vehicle are formulated in six degrees of freedom; a flat, nonrotating earth is assumed. The independent equations of motion of up to five oleo-type landing gears are also formulated. A control management formulation is developed to automatically adjust control variables to correct errors in the vehicle's dynamic state. Stability in the small is used to maintain stability in the large. The equations of motion are integrated using a generalized variable-step Runge-Kutta technique. (Modified author abstract) GRA

N75-15625# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

AEROMECHANICAL ANALYSIS OF A TOW TARGET SYSTEM INSTALLED ON THE A-4 AIRPLANE

D. W. Carroll 4 Sep. 1974 167 p refs

(AD-787059; NADC-74150-30) Avail: NTIS CSCL 01/3

The tow target system installation, analyzed in this report is intended for towing large towed targets for air-to-air and surface-to-air weapon training firing exercises. The system will also provide for the towing of smaller towed targets at towline lengths exceeding 6 miles. The analysis indicates that the installation is adequate, structurally, for target towing missions which are within the capability of the A-4 airplane. Flight test of the system is recommended to determine suitability for service use.

Author (GRA)

N75-15626* Massachusetts Inst. of Tech., Cambridge, Electronic Systems Lab.

APPLICATION OF MODERN CONTROL THEORY TO SCHEDULING AND PATH-STRETCHING MANEUVERS OF AIRCRAFT IN THE NEAR TERMINAL AREA

Michael Athans Oct. 1974 28 p refs

(Grants NGL-22-009-124; AF-AFOSR-69-1724;

AF-AFOSR-72-2273; MIT Proj. OSP-76265)

(NASA-CR-142058; ESL-R-574) Avail: NTIS HC \$3.75 CSCL 17G

A design concept of the dynamic control of aircraft in the near terminal area is discussed. An arbitrary set of nominal air routes, with possible multiple merging points, all leading to a single runway, is considered. The system allows for the automated determination of acceleration/deceleration of aircraft along the nominal air routes, as well as for the automated determination of path-stretching delay maneuvers. In addition to normal operating conditions, the system accommodates: (1) variable commanded separations over the outer marker to allow for takeoffs and between successive landings and (2) emergency conditions under which aircraft in distress have priority. The system design is based on a combination of three distinct optimal control problems involving a standard linear-quadratic problem, a parameter optimization problem, and a minimum-time rendezvous problem.

Author

N75-15627* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A GENERAL ALGORITHM FOR RELATING GROUND TRAJECTORY DISTANCE, ELAPSED FLIGHT TIME, AND AIRCRAFT AIRSPEED AND ITS APPLICATION TO 4-D GUIDANCE

Edwin C. Foudriat Washington Feb. 1975 23 p refs

(NASA-TN-D-7876; L-9932) Avail: NTIS HC \$3.25 CSCL 17B

A general solution using an elliptic integral approximation which relates flight time, aircraft airspeed, and ground distance on straight-line and circular-arc trajectory segments is developed. The solution procedure is applicable to both constant and accelerating aircraft flight. In addition, wind shear including both magnitude and heading change is incorporated in the solution. The solution equations are used in a four-dimensional (4-D) control algorithm where both flight time and final airspeed are specified. The results show that the algorithm converges rapidly and accurately.

Author

N75-15628* Semcor, Inc., Moorestown, N.J.

A COMPUTER SIMULATION STUDY OF THE GENERAL PURPOSE MULTIPLEX SYSTEM GPMS APPLIED TO THE INFORMATION TRANSFER REQUIREMENTS OF THE A-7E AIRCRAFT. VOLUME 1: METHODOLOGY AND RESULTS Final Report, 5 Nov. 1973 - 19 Sep. 1974

John J. Kearney 16 Oct. 1974 126 p refs

(Contract N62269-74-C-0185)

(AD-787544; SR-JJK-74-289-1) Avail: NTIS CSCL 17/2

The General Purpose Multiplex System (GPMS) and the avionics data transfer load of the A-7E aircraft were modeled and simulated on a digital computer. System behavior was examined by a series of six runs, which were conducted under normal and casualty conditions for various data loads and GPMS architectures. GPMS is a flexible general purpose multiplex system designed to transfer avionics information aboard Naval aircraft. The report is presented in two volumes. Volume I describes the methodology used to model the GPMS and the A-7E information transfer requirements for the simulation. The

analysis of the simulation results and significance of those results are also presented in Volume I. Recommendations for future GPMS design based on the simulation results are given and areas requiring further study are indicated. (Modified author abstract)

GRA

N75-15632# Boeing Commercial Airplane Co., Seattle, Wash. **STRATEGIC CONTROL ALGORITHM DEVELOPMENT. VOLUME 1: SUMMARY Final Report, Nov. 1972 - Dec. 1973**

R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, and A. L. Yarrington Aug. 1974 71 p refs

(Contract DOT-TSC-538)

(PB-236719/1; DOT-TSC-OST-74-3-1) Avail: NTIS HC \$4.25

HC also available from NTIS \$34.00/set of 6 reports as PB-236718-SET CSCL 17G

Strategic control is an air traffic management concept wherein a central control authority determines, and assigns to each participating airplane, a conflict-free, four-dimensional route-time profile. This concept results in terminal area capacity increases, delay reductions, safety improvement, and controller workload reductions. Maximum benefits are expected to occur at the busy terminal areas where demand is high and airspace is at a premium. The results of a study to develop the basic algorithm for strategic control of arrivals are summarized. The strategic control concept is described as to operational concept, ATC system, airplane system, and application to U.S. airspace. (Modified author abstract)

GRA

N75-15633# Boeing Commercial Airplane Co., Seattle, Wash. **STRATEGIC CONTROL ALGORITHM DEVELOPMENT. VOLUME 2A: TECHNICAL REPORT Final Report, Nov. 1972 - Dec. 1973**

R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, and A. L. Yarrington Aug. 1974 236 p

(Contract DOT-TSC-538)

(PB-236720/9; DOT-TSC-OST-74-3-2A) Avail: NTIS HC \$7.50

HC also available from NITS \$34.00/set of 6 reports as PB-236718-SET CSCL 17G

The technical report presents a detailed description of the strategic control functional objectives, followed by a presentation of the basic strategic control algorithm and how it evolved. Contained in this discussion are results of analyses that constrain the design and operation of the strategic control algorithm and a description of the model developed to simulate strategic terminal area operation in order to develop and evaluate the algorithm. The data processing sizing requirements and the application of the strategic control algorithm in terms of time periods and airspace to be served are presented with an overall summary of the benefits of the system. Finally, a proposed research, development, test, and evaluation plan is detailed for developing the strategic control system capabilities for implementation as the primary air traffic management technique for high-density air routes and terminal areas.

GRA

N75-15634# Boeing Commercial Airplane Co., Seattle, Wash. **STRATEGIC CONTROL ALGORITHM DEVELOPMENT. VOLUME 2B: TECHNICAL REPORT (CONCLUDED) Final Report, Nov. 1972 - Dec. 1973**

R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, and A. L. Yarrington Aug. 1974 180 p refs

(Contract DOT-TSC-538)

(PB-236721/7; DOT-TSC-OST-74-3-2B) Avail: NTIS HC \$7.00

HC also available from NTIS \$34.00/set of 6 reports as PB-236718-SET CSCL 17G

N75-15635# Boeing Commercial Airplane Co., Seattle, Wash. **STRATEGIC CONTROL ALGORITHM DEVELOPMENT. VOLUME 3: STRATEGIC ALGORITHM REPORT Final Report, Nov. 1972 - Dec. 1973**

R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, and A. L. Yarrington Aug. 1974 91 p refs

(Contract DOT-TSC-538)

(PB-236722/5; DOT-TSC-OST-74-3-3) Avail: NTIS HC \$4.75
HC also available from NTIS \$34.00/set of 6 reports as
PB-236718-SET CSCL 17G

The strategic algorithm report presents a detailed description of the functional basic strategic control arrival algorithm. This description is independent of a particular computer or language. Contained in this discussion are the geometrical and environmental considerations and the required arrival traffic data requirements. The methods of providing sequencing and control point scheduling are discussed as is the means of developing a conflict-free, four-dimensional route-time profile that achieves the scheduling objectives. GRA

N75-15636# Boeing Commercial Airplane Co., Seattle, Wash.
STRATEGIC CONTROL ALGORITHM DEVELOPMENT. VOLUME 4A: COMPUTER PROGRAM REPORT Final Report, Nov. 1972 - Dec. 1973

R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, and A. L. Yarrington Aug. 1974 272 p
(Contract DOT-TSC-538)

(PB-236723/3; DOT-TSC-OST-74-3-4A) Avail: NTIS HC \$8.50
HC also available from NTIS \$34.00/set of 6 reports as
PB-236718-SET CSCL 17G

A description of the strategic algorithm evaluation model is presented, both at the user and programmer levels. The model representation of an airport configuration, environmental considerations, the strategic control algorithm logic, and the airplane simulation model are delineated, together with data inputs and outputs. Detailed instructions for running the model include the input deck setup. Listings of the complete program, as well as detailed logic flow charts and a variable dictionary, are included. Program storage requirements and machine dependence considerations are also discussed. GRA

N75-15637# Boeing Commercial Airplane Co., Seattle, Wash.
STRATEGIC CONTROL ALGORITHM DEVELOPMENT. VOLUME 4B: COMPUTER PROGRAM REPORT (CONCLUDED) Final Report, Nov. 1972 - Dec. 1973

R. L. Erwin, M. J. Omoth, W. H. Galer, D. Hartnell, and A. L. Yarrington Aug. 1974 272 p
(Contract DOT-TSC-538)

(PB-236724/1; DOT-TSC-OST-74-3-4B) Avail: NTIS
HC \$8.50 CSCL 17G

N75-15638# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 1: SUMMARY Final Report, Nov. 1972 - Jan. 1974

F. Mertes and L. Jenney Aug. 1974 196 p refs
(Contract DOT-TSC-512)

(PB-236801/7; DOT-TSC-OTS-74-14-1-Vol-1) Avail: NTIS
HC \$7.00 CSCL 17G

The Advanced Air Traffic Management System (AATMS) program is a long range investigation of new concepts and techniques for controlling air traffic and providing services to the growing number of commercial, military, and general aviation users of the national airspace. The purposes were to specify and describe the desirable extent of automation of AATMS, to estimate the requirements for man and machine resources associated with such a degree of automation, and to examine the prospective employment of humans and automata as air traffic management is converted from a labor-intensive to a machine-intensive activity. GRA

N75-15639# Clemson Univ., S.C. Mechanical Engineering Dept.

OPTIMIZATION OF STRUCTURES TO SATISFY AEROELASTIC REQUIREMENTS Final Technical Report

Carl S. Rudisill Feb. 1975 29 p refs
(Grant NGR-41-001-027)

(NASA-CR-142021) Avail: NTIS HC \$3.75 CSCL 20K

A method for the optimization of structures to satisfy flutter velocity constraints is presented along with a method for

determining the flutter velocity. A method for the optimization of structures to satisfy divergence velocity constraints is included. Author

N75-15640# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

FLIGHT INVESTIGATION OF ROTOR/VEHICLE STATE FEEDBACK

Stanley J. Briczinski and Dean E. Cooper [1975] 173 p refs
Sponsored in part by Army Air Mobility R and D Lab., Hampton, Va.

(Contract NAS1-11563)

(NASA-CR-132546; SER-50905) Avail: NTIS HC \$6.25 CSCL 01C

The feasibility of using control feedback or rotor tip-path-plane motion or body state as a means of altering rotor and fuselage response in a prescribed manner was investigated to determine the practical limitations of in-flight utilization of a digital computer which conditions and shapes rotor flapping and fuselage state information as feedback signals, before routing these signals to the differential servo actuators. The analysis and test of various feedback schemes are discussed. Test results show that a Kalman estimator routine which is based on only the first harmonic contributions of blade flapping yields tip-path-plane coefficients which are adequate for use in feedback systems, at speeds up to 150 kts. F.O.S.

N75-15641# Advisory Group for Aerospace Research and Development, Paris (France).

EFFECTS OF SURFACE WINDS AND GUSTS ON AIRCRAFT DESIGN AND OPERATION

Nov. 1974 95 p refs

(AGARD-R-626) Avail: NTIS HC \$4.75

An analysis of the effects of surface winds and gusts on aircraft stability and control is presented. The analysis is applied to the development of airframes, improvement of basic airworthiness, better flight characteristics through gust load alleviation, and methods for avoiding atmospheric turbulence. The subjects discussed are as follows: (1) the wind characteristics in the planetary boundary layer, (2) research on aeronautical effects of surface winds and gusts, and (3) the use of radiosonde data to derive atmospheric wind shears for small shear increments. Graphs and tables of wind characteristics, wind speed dispersion, and statistical analyses of gust load conditions.

N75-15643 Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

UK RESEARCH ON AERONAUTICAL EFFECTS OF SURFACE WINDS AND GUSTS

J. G. Jones In AGARD Effects of Surface Winds and Gusts on Aircraft Design and Operation Nov. 1974 p 59-78 refs

An outline of topics concerning aeronautical effects of surface winds and gusts currently under investigation in the UK or planned for future research is presented. Emphasis is upon effects on aircraft handling and ride qualities, although attention is drawn to the influence of handling performance upon loads experienced in turbulence. Particular areas discussed include turbulence models and related procedures for aircraft airworthiness requirements, turbulence models for ground-based simulation, criteria for aircraft ride quality, the representation of the human pilot in analytical studies of flight in turbulence, and the use of active controls for gust alleviation. Author

N75-15645# ARO, Inc., Arnold Air Force Station, Tenn.
EFFECT OF VARIOUS EXTERNAL STORES ON THE AERODYNAMIC CHARACTERISTICS OF THE F-4C AIRCRAFT Final Report, 10 Sep. - 13 Oct. 1973

J. M. Whorric AEDC Oct. 1974 169 p refs
(AF Proj. 2567; ARO Proj. PA305)

(AD-787657; ARO-PWT-TR-74-50; AFATL-TR-74-113; AEDC-TR-74-75) Avail: NTIS CSCL 01/3

The results obtained from wind tunnel tests, which were conducted to determine the effects of external carriage of several configurations of winged stores on the aerodynamic characteristics of the F-4C aircraft, are presented and discussed. The analysis includes evaluation of the static longitudinal stability, drag, and longitudinal control characteristics of the F-4C aircraft with winged stores. Incremental drag rise and neutral-point shift associated with some of the store loadings are compared with results obtained from existing prediction techniques and methods. (Modified author abstract) GRA

N75-15646# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

THE PROPER SELECTION OF ENGINE CYCLES Final Report, Apr. 1970 - Jun. 1973

Robert J. May, Jr. and J. Alan Rowlands Apr. 1974 65 p refs

(AF Proj. 3066)

(AD-787654; AFAPL-TR-73-118) Avail: NTIS CSCL 01/1

The work proposes the nucleus of an engine airframe integration methodology evolved at the Air Force Aero Propulsion Laboratory, drawing on a considerable number of past integration efforts, both successful and unsuccessful. Only the nucleus is presented so as to encourage each contractor to apply his unique expertise and improve individual segments of the methodology. This common method of approaching the problem of engine-airframe integration should stimulate communication within the field of integration. The methodology also provides the ability to meet reasonable changes in system requirements and the problems encountered in component performance in an orderly fashion rather than in a crisis management atmosphere. GRA

N75-15647# Air Force Flight Test Center, Edwards AFB, Calif. **A COMPARISON AND EVALUATION OF TWO METHODS OF EXTRACTING STABILITY DERIVATIVES FROM FLIGHT TEST DATA Final Report**

Paul W. Kirster and Lawrence G. Ash May 1974 86 p refs (AD-787645; AFFTC-TD-73-5) Avail: NTIS CSCL 01/2

Two methods for extracting stability derivatives from flight data are compared. A modified Newton-Raphson minimization technique and a digital-analog (hybrid) matching technique were used to analyze the same data maneuvers obtained from two aircraft. About 55 maneuvers of an F-111E aircraft were analyzed over a Mach number range of 0.3 to 2.0 and an angle of attack range of 3 to 19 degrees. About 15 maneuvers were analyzed for the X-24A lifting body at Mach numbers of 0.8 and 0.9 and an angle of attack range of 4 to 13 degrees. Stability derivatives were extracted from these maneuvers, and the results from the two techniques along with wind tunnel results were compared. (Modified author abstract) GRA

N75-15649# Royal Aircraft Establishment, Farnborough (England).

MODERN FLIGHT PATH RECORDING EQUIPMENT

A. Tert Oct. 1974 26 p Transl. into ENGLISH from the AGARD Flight Mech. Meeting, Edinburgh, 1974 (French language document)

(RAE-Lib-Trans-1799; BR44351) Avail: NTIS HC \$3.75

Methods for recording take-off and landing flight paths were investigated. Laser radar proved to be a suitable means for the precise flight path recording required in tests on all-weather landing equipment. Airborne equipment using inertial platforms met the requirements of performance flight path recording, while rendering the aircraft independent of its test base, provided that a correction procedure is used. Author

N75-15651# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

NORMAL INJECTION OF HELIUM FROM SWEEP STRUTS INTO DUCTED SUPERSONIC FLOW

Charles R. McClinton and Marvin G. Torrence Jan. 1975 58 p refs

(NASA-TM-X-72632) Avail: NTIS HC \$4.25 CSCL 01B

Recent design studies have shown that airframe-integrated scramjets should include instream mounted, swept-back strut fuel injectors to obtain short combustors. Because there was no data in the literature on mixing characteristics of swept strut fuel injectors, the present investigation was undertaken to provide such data. This investigation was made with two swept struts in a closed duct at Mach number of 4.4 and nominal jet-to-air mass flow ratio of 0.029 with helium used to simulate hydrogen fuel. The data is compared with flat plate mounted normal injector data to obtain the effect of swept struts on mixing. Three injector patterns were evaluated representing the range of hole spacing and jet-to-freestream dynamic pressure ratio of interest. Measured helium concentration, pitot pressure, and static pressure in the downstream mixing region are used to generate contour plots necessary to define the mixing region flow field and the mixing parameters. Author

N75-15652*# Pratt and Whitney Aircraft, East Hartford, Conn. **TWO-STAGE FAN. 4: PERFORMANCE DATA FOR STATOR SETTING ANGLE OPTIMIZATION**

G. D. Burger and M. J. Keenan Jan. 1975 301 p refs

(Contract NAS3-13494)

(NASA-CR-134717; PWA-5225) Avail: NTIS HC \$9.25 CSCL 21E

Stator setting angle optimization tests were conducted on a two-stage fan to improve efficiency at overspeed, stall margin at design speed, and both efficiency and stall margin at partspeed. The fan has a design pressure ratio of 2.8, a flow rate of 184.2 lb/sec (83.55 kg/sec) and a 1st-stage rotor tip speed of 1450 ft/sec (441.96 in/sec). Performance was obtained at 70, 100, and 105 percent of design speed with different combinations of 1st-stage and 2nd-stage stator settings. One combination of settings, other than design, was common to all three speeds. At design speed, a 2.0 percentage point increase in stall margin was obtained at the expense of a 1.3 percentage point efficiency decrease. At 105 percent speed, efficiency was improved by 1.8 percentage points but stall margin decreased 4.7 percentage points. At 70 percent speed, no change in stall margin or operating line efficiency was obtained with stator resets although considerable speed-flow regulation occurred. Author

N75-15653*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FORWARD VELOCITY EFFECTS ON UNDER-THE-WING EXTERNALLY BLOWN FLAP NOISE

J. Goodykoontz, U. VonGlahn, and R. Dorsch 1975 21 p refs Proposed for presentation at 2d Aero-Acoustics Specialists Conf., Hampton, Va., 24-26 Mar. 1975; sponsored by AIAA

(NASA-TM-X-71656; E-8235) Avail: NTIS HC \$3.25 CSCL 20A

Noise tests were conducted with small-scale models of externally blown-flap powered-lift systems that were subjected to simulated takeoff and landing free-stream velocities by placing the nozzle-wing models in a free jet. The nozzle configurations consisted of a conical and an 8-tube mixer nozzle. The results show that the free-stream velocity attenuates the noise from the various configurations, with the amount of attenuation depending on the flap setting. More attenuation was obtained with a flap setting of 20 degrees than with a flap setting of 60 degrees. The dynamic effect on the total attenuation caused by aircraft motion is also discussed. Author

N75-15654# Dayton Univ. Research Inst., Ohio. **ENCAPSULATED TUNED DAMPERS FOR JET ENGINE COMPONENT VIBRATION CONTROL (LOG NO. C2364)**

Michael L. Parin and David I. G. Jones (AFML) 16 Jan. 1975 30 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in May 1975 (AF Proj. 735106)

Avail: NTIS HC \$3.75 CSCL 21E

An investigation of the dynamic behavior of an encapsulated-beam tuned damping device was conducted. The tests involved isolation and reduction of the vibration levels in a jet engine turbine blade at high temperatures. The investigation showed that such a damper is feasible. Some of the engineering difficulties

which must be overcome for successful operation at high temperatures and centrifugal loadings are discussed. Author

N75-15666# Technische Universitaet, Munich (West Germany). **VIBRATORY WAVES OF TURBOMACHINERY: A CONTRIBUTION TO IMPROVED MEASUREMENT RESULTS** Ph.D. Thesis [WELLEN SCHWINGUNGEN AN TURBOMASCHINEN: EIN BEITRAG ZUR VERBESSERUNG DER AUSSAGEKRAFT BEI MESSUNGEN] Helmut Geis 16 Jul. 1974 142 p refs In GERMAN Avail: NTIS HC \$5.75

Linearized differential equations are used to formulate a method for calculating vibrational amplitude variations inside the casing or bearing of large turbine rotors from measurements in the gap between bearing block and casing. Transl. by G.G.

N75-15668# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. **ENGINE DEVELOPMENT PROGRAM FOR THE APL REMOTELY PILOTED VEHICLE** T. R. Small Jul. 1974 35 p (Contract N00017-72-C-4401) (AD-787507; APL-TG-1249) Avail: NTIS CSCL 01/3

Performance of a custom-built (Sakert-Riggs) two-cylinder glow plug engine for use in the APL Remotely Piloted Vehicle was tested. Output power was less than expected, and plans to modify the engine to increase its power were foiled because of the early discovery of a structural weakness that showed up in every unit tested. An alternate engine was then developed, based on a low-cost proven design (McCulloch) that had been in quantity production for a number of years. This engine showed higher peak power and weighs more, but requires less than one-fourth the fuel at cruise power, primarily because it uses spark plug ignition with gasoline rather than glow plug ignition with methanol. Late in the test program, another brand (Kolbo) custom-built two-cylinder glow plug engine was introduced. Limited testing showed it to be a satisfactory, lightweight, but fuel-hungry engine. Author (GRA)

N75-15660# ARO, Inc., Arnold Air Force Station, Tenn. **EXPERIMENTAL VERIFICATION OF A TRANSONIC TEST TECHNIQUE FOR FULL-SCALE INLET/ENGINE SYSTEMS SIMULATING MANEUVERING ATTITUDES** Final Report. 1 Jul. 1973 - 30 Jun. 1974 R. L. Palko AEDC Oct. 1974 36 p refs (ARO Proj. PF418; ARO Proj. PA428) (AD-787659; ARO-PWT-TR-74-51; AEDC-TR-74-80) Avail: NTIS CSCL 21/5

An experimental investigation was conducted to demonstrate the capability of a newly developed flow-shaping technique to test full-scale inlet/engine systems in the AEDC 16-ft Propulsion Wind Tunnel (transonic) at angles of yaw and combinations of angle of attack and yaw. Simulation of the flow field approaching the inlet was accomplished at Mach numbers in the range from 0.6 to 0.9 at positive yaw angles up to 6 deg over an angle-of-attack range from 0 to 8 deg and at negative yaw angles up to 6 deg over an angle of attack range from 0 to 12 deg. Inlet pressure distribution (ramp, lip, and sideplate), local flow angularity, and local Mach number in front of the inlet were used to verify the technique. (Modified author abstract) GRA

N75-15661# Naval Postgraduate School, Monterey, Calif. **THE PULSEJET ENGINE: A REVIEW OF ITS DEVELOPMENT POTENTIAL** M.S. Thesis John Grant OBrien Jun. 1974 120 p refs (AD-787439) Avail: NTIS CSCL 21/5

The pulsejet was the object of much concentrated study immediately after World War II, but in spite of this intense

study, the pulsejet has never lived up to its promised performance. Recently, there has been a renewal of interest in the pulsejet and a considerable amount of research and experimentation has been conducted. Some recent developments are: pulsejets which are capable of supersonic operation, use of pulsejets for auxiliary power generation, and attempts to use a pulsejet as a combustor for a gas turbine engine. This paper reviews this recent work and includes thermodynamic analysis, a description of wave processes, and a description of the ignition mechanism. The problems of noise and vibration are also addressed. From this study of recent work, several potential applications are proposed, and recommendations about areas requiring further study are made. Author (GRA)

N75-15663# Arnold Engineering Development Center, Arnold Air Force Station, Tenn. **GROUND SIMULATION OF MANEUVER FORCES ON TURBINE ENGINES** Gerald M. Mulenburg 1 Aug. 1974 32 p Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in May 1975 Avail: NTIS HC \$3.75

The results of a study that identifies the need for, and feasibility of, ground simulation of flight maneuver forces on turbine engines are reported. The main emphasis of the study is on the application of realistic combinations of gyroscopic forces and g loads to an operating turbine engine. After confirming that a requirement exists for this type of testing, identification of basic test parameters leads to the development of several test facility concepts. Analysis of the facility concepts for their ability to duplicate the desired load spectrum and for construction feasibility reduces the number to a few promising designs. Detailed trade-off studies and cost analyses of these selected designs and their subsystems, including advanced instrumentation techniques, allow further evaluation of their potential as test facilities. The findings of the study include substantiating data and assumptions. Author

N75-15666# Tracor, Inc., Austin, Tex. **ANALYSIS OF THE 1972 PERFORMANCE OF THE DYNAMIC PREFERENTIAL RUNWAY SYSTEM AT JOHN F. KENNEDY INTERNATIONAL AIRPORT** Richard D. Edmiston Sep. 1974 84 p refs (Contract DOT-FA71EA-6355) (AD-787709; TRACOR-T74-AU-9579-U) Avail: NTIS CSCL 01/5

For several years Tracor, Inc., the Federal Aviation Administration, the Port of New York and New Jersey Authority, and the Aviation Development Council of New York have pursued an active program of improving the preferential runway system at John F. Kennedy International Airport (JFK). This effort culminated in the development and installation of a Dynamic Preferential Runway System (DPRS), which was designed to break up long periods of continuous community exposure to aircraft overflight while still distributing overflight among communities as equitably as possible. The installation and operation of the DPRS is described in an earlier report. (AD-787 713). This report presents a quantitative analysis of the effect of the DPRS on operations at JFK for August and September of 1972. (Modified author abstract) GRA

N75-15672# RAND Corp., Santa Monica, Calif. **AN EXPERIMENTAL INVESTIGATION OF PRIORITY DISPATCHING IN AIRCRAFT MAINTENANCE, USING A SIMPLIFIED MODEL** L. W. Miller, A. S. Ginsburg, and W. L. Maxwell Jun. 1974 34 p refs (Contract F44620-73-C-0011) (AD-787881; R-1385-PR) Avail: NTIS CSCL 15/5

An attempt to elucidate the ways in which priority policy affects product completion time. A simple model of a product-assembly (or aircraft-maintenance) shop's processes was created, and products consisting of one or more jobs were fed into it. Three general categories of priority policy were tested: those

(a) determined by job length, number of jobs in a product, or total product-processing requirement, (b) determined by status of jobs in a product, and (c) determined by current resource commitments. It turned out that there is a dependence among the choices, i.e., the best choice in (b) varies with the attribute selected in (a). The best procedure among those tried was an unstarted work content rule. That is, give highest priority to the set of waiting jobs whose product has the least sum of processing times. The statistical significance of the experimental results is discussed and a concluding section relates this study to the real world problem that motivated it. Author (GRA)

N75-15676# Sandia Labs., Albuquerque, N.Mex.
LAUNCH AND ACCELERATION ENVIRONMENT TESTING: SYSTEMS TEST LABORATORY, SANDIA LABORATORIES
 L. M. Spivey Aug. 1974 28 p refs
 (Contract AT(29-1)-789)
 (SLL-74-0015) Avail: NTIS HC \$3.75

The utility of the high-performance centrifuge is demonstrated in connection with the testing of two payloads flown in the FY74 Sandia/ABRES Material Study test program. The test results indicated the importance of a facility capable of closely simulating flight environments. Author (NSA)

N75-15803* Carborundum Co., Niagara Falls, N.Y. Research and Development Div.
DEVELOPMENT OF A THERMAL ACOUSTICAL AIRCRAFT INSULATION MATERIAL Final Technical Report
 Ruey Y. Lin and Edward A. Struzik Nov. 1974 48 p
 (Contract NAS9-13641)
 (NASA-CR-141498) Avail: NTIS HC \$3.75 CSCL 11G

A process was developed for fabricating a light weight foam suitable for thermal and acoustical insulation in aircraft. The procedures and apparatus are discussed, and the foam specimens are characterized by numerous tests and measurements. N.E.R.

N75-15917# Office of Naval Research, London (England).
MECHANICS AND FLUID MECHANICS AT DELFT
 H. G. Elrod 23 Sep. 1974 12 p refs
 (AD-787628; ONRL-R-7-74) Avail: NTIS CSCL 20/4

This report summarizes the research activities of some prominent Delft professors involved in lubrication, jet mixing, turbulence, rheology and aeronautics. Author (GRA)

N75-16148# Environmental Health Lab., Kelly AFB, Tex.
HAZARDOUS NOISE AND INDUSTRIAL HYGIENE SURVEY, 910 TAC FIGHTER GROUP (AFRES), YOUNGSTOWN MUNICIPAL AIRPORT, VIENNA, OHIO 44473
 Lawrence W. Grauvogel Sep. 1974 42 p refs
 (AD-787652; EHL(K)-74-24) Avail: NTIS CSCL 06/10

At the request of Headquarters, Central Air Force Reserve Region, Ellington AFB TX, a hazardous noise and industrial hygiene survey was conducted 22-24 May 1974 for the 910 TAC Fighter Group (AFRES), Youngstown MA, Vienna OH 44473. Personnel exposed to potentially hazardous noise and sources and areas of potentially hazardous noise are identified by shop. Ventilation, thermal stress and illumination are discussed for each shop and recommendations made. Comprehensive listings by shop of chemicals used and composition are included to aid the physician in identification of the possible source of occupational illnesses encountered. Author (GRA)

N75-16241 Ferranti, Ltd., Bracknell (England).
AVIONICS SYSTEM ARCHITECTURE
 R. E. Wright In AGARD Principles of Avionics Computer Systems Dec. 1974 p 64-87 refs

The system architect's task is to define and combine a set of hardware components to form a system whose aggregate behavior will meet the operational requirement for the system. Most avionic systems start with an operational requirement

specified by a user or airframe manufacturer. During the short history of aviation there has been a growth of such operational needs which have presented problems requiring technical solutions. The avionic system derives much from the general development in system engineering, but is subject to particular operational requirements, physical environments, and physical constraints which together justify a somewhat specialized approach. Some of the problems and techniques involved are briefly described and discussed. A.L.

N75-16243 Smiths Industries Ltd., London (England). Aviation Div.
MONITORING AND CONTROL OF AEROSPACE VEHICLE PROPULSION
 E. S. Eccles In AGARD Principles of Avionics Computer Systems Dec. 1974 p 119-142 refs

Avail: NTIS

The application of digital computer systems to the design of systems for monitoring and control of the propulsion of aerospace vehicles is discussed. The general context is related to commercial operation of vehicles using airbreathing engines. This limitation permits concentration of attention on the systems problem and removes the need for any extensive discussion of powerplant characteristics. The restriction is not serious in terms of broad powerplant characteristics. The basic features of control requirements are common to all plants using chemical energy sources and combustion for energy conversion. There are strong conceptual similarities, for instance, between throttleable rocket motors and augmented (reheated) gas turbine powerplants. Time constants and thrust levels differ but the basic problems of mixture control via independent fuel and oxidant flow control and their pumping (in the general sense) remain the same. The plant control details will be less relevant to systems using hypergolic fuels and nuclear or electric propulsion. In the same way, the operational criteria will be similar for vehicles which, in themselves, are as different as the space shuttle and STOL feeder liner systems. Commercial and military operational criteria also have many analogous, if not entirely homologous, features. Similar design trade-offs are involved for both types of organizational structure and mission objectives. The discussion identifies the basic principles involved and enables read-across to other types of operation and to other avionics systems disciplines. Author

N75-16291 Ministry of Defence, London (England).
DEVELOPMENT EXPERIENCES OF REAL TIME COMPUTER BASED SYSTEMS IN STRIKE AIRCRAFT
 C. J. U. Roberts In AGARD Real Time Computer Based Systems Dec. 1974 6 p

This paper will describe the nav/attack system that is fitted to the UK version of the Jaguar aircraft with particular reference to its computing sub-system. The paper will also discuss the effect that the flexibility of digital computing has had on the flight trials program together with some of the salutary experience that has been gained on the inter-relationships of hardware and software and the need for a disciplined validation process for the flight program software. Author

N75-16292 International Business Machines Corp., Owego, N.Y.
LAMPS: A CASE HISTORY OF PROBLEMS/DESIGN OBJECTIVES FOR AN AIRBORNE DATA HANDLING SUBSYSTEM
 Rex Reed and Howard J. Cattie, Jr. (NADC, Warminster, Pa.) In AGARD Real Time Computer Based Systems Dec. 1974 11 p

This paper is presented to clarify and broaden the understanding of the problems relating to computer-based realtime systems. A current U.S. Navy avionics data handling subsystem aboard a destroyer-based helicopter, will be reviewed as it progressed from the concept evaluation and flight test phases of an engineering test bed to the present engineering prototype. An analysis of the test bed's positive and negative data handling features are discussed with respect to their influence on the follow-on design. The prevailing philosophies and constraints surrounding such a

development impacts the design alternatives while a balancing of hardware/software parameters assists in optimizing system performance. Finally, the importance, even in the early design efforts of hardware/software cooperation is emphasized if an optimum design is to be achieved within the surrounding realities. Such early cooperation, as seen in the example, is felt to have optimized hardware design as well as eliminated much of the software required to rectify the lack of desirable, or even essential hardware features typical of independent design efforts. Author

N75-16293 IBM Italia, Rome.

DIGITAL REAL TIME SIMULATION OF FLIGHT

Nunzio LaFerlita In AGARD Real Time Computer Based Systems Dec. 1974 17 p refs

The simulation of flight is discussed, producing real-time phenomenon. The problems arising from general purpose digital computers to simulate real-time flight are investigated. M.C.F.

N75-16294 Eurocontrol Agency, Maastricht (Netherlands).

THE MAASTRICHT DATA PROCESSING AND DISPLAY SYSTEM: A STEP IN AUTOMATION OF AIR TRAFFIC CONTROL (THE SOFTWARE STRUCTURE OF THE SYSTEM)

R. Ehrmanntraut In AGARD Real Time Computer Based Systems Dec. 1974 14 p

The system performs multi radar tracking on data from up to 6 radar stations. Extensive checks of data entering the system, especially for flight plans, are carried out. The system performs correlation of plans and tracks. Information in the data bank is automatically updated by radar. Technical particularities concerning the degree of modularity are discussed, and data bank structure and some supervisory aspects are highlighted. It is shown that in the event of a hardware or software failure, a system reconfiguration will take place. In case the main computer fails, restart takes place from safe data on disk memory. Author

N75-16314* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE NOISINESS OF LOW FREQUENCY BANDS OF NOISE

Ben William Lawton Feb. 1975 17 p refs Presented at 88th Meeting of the Acoustical Soc. of Am., St. Louis, 4-8 Nov. 1974

(NASA-TM-X-72649) Avail: NTIS HC \$3.25 CSCL 20A

The relative noisiness of low frequency 1/3-octave bands of noise was examined. The frequency range investigated was bounded by the bands centered at 25 and 200 Hz, with intensities ranging from 50 to 95 db (SPL). Thirty-two subjects used a method of adjustment technique, producing comparison band intensities as noisy as 100 and 200 Hz standard bands at 60 and 72 db. The work resulted in contours of equal noisiness for 1/3-octave bands, ranging in intensity from approximately 58 to 86 db (SPL). These contours were compared with the standard equal noisiness contours; in the region of overlap, between 50 and 200 Hz, the agreement was good. Author

N75-16504* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STATIC TESTS OF A SIMULATED UPPER SURFACE BLOWN JET-FLAP CONFIGURATION UTILIZING A FULL-SIZE TURBOFAN ENGINE

James P. Shivers and Charles C. Smith, Jr. Washington Feb. 1975 41 p

(NASA-TN-D-7816; L-9712) Avail: NTIS HC \$3.75 CSCL 01A

The investigation utilizing a small turbofan engine was conducted to evaluate static turning performance and pressure and temperature environment of an upper surface blown wing and flap segment. The tests involved modifications of the engine primary nozzle to alleviate high-temperature problems on the wing and flaps without adversely affecting static turning performance over the desired range of flap deflection and thrust condition. Author

N75-16505# European Space Research Organization, Paris (France).

A CONTRIBUTION TO THE NONLINEAR LIFT AND PITCHING MOMENT PROPERTIES OF SLIM WING-BODY COMBINATIONS

Horst Otto Oct. 1974 70 p refs Transl. into ENGLISH of Ein Beitr. zu den nichtlinearen Auftriebs- u. Nickmomenteneigenschaften von schlanken Fluegel-Rumpf-Kombinationen, DLR-FB-73-66, DFVLR, 12 Apr. 1973

(ESRO-TT-101; DLR-FB-73-66) Avail: NTIS HC \$4.25; DFVLR, Porz, West Ger. 15.50 DM

The nonlinear aerodynamic properties of slender wing-body combinations in incompressible flow were studied by means of three component measurements and flow investigations. In these tests the wings were located at the center line of the fuselages and their rear position was altered in a wide range. Considering the most important nonlinear influences determined from these experiments, the linear wing-body theory after X. HAFFER is extended to the calculation of the nonlinear lift and pitching moment coefficients of slender wing-body combinations. In this approach the wing is represented by a vortex model consisting of a vortex sheet, which is bent off at the trailing edge of the wing, as well as by the vortex model of the nonlinear lifting surface theory of K. GERSTEN. The results of sample calculations, carried out for slender wing-body combinations at different rear positions of the wings with respect to the fuselages, are compared with experimental results. Author (ESRO)

N75-16506 British Library Lending Div., Boston Spa (England).
THE VIBRATIONS OF A CYLINDER IN THE WAKE OF ANOTHER. ANALYSIS OF THE PHENOMENA WITH AN ANALYTICAL MODEL

G. Diana and F. Giordana 30 Oct. 1973 29 p refs Transl. into ENGLISH from Energia Elettrica (Italy), no. 7, 1972 p 448-457

(BLL-CE-Trans-6185-(9022.09)) Avail: British Library Lending Div., Boston Spa, Engl.; 3 BLL photocopy coupons

A mathematical model is proposed which enables the principal characteristics of the phenomenon of vibrations induced by the wake effect to be demonstrated. The analysis conducted on this model makes it possible to determine the range of wind velocity which gives rise to instabilities of the flutter type and formulae for practical application are presented. A method for estimating the damping required to prevent the phenomenon arising is also proposed. Some numerical results are given relating to the case of bundles of conductors with sub-conductor spacings presently in use. Author

N75-16509* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF EXPERIMENTAL AND THEORETICAL BOUNDARY-LAYER SEPARATION FOR INLETS AT INCIDENCE ANGLE AT LOW-SPEED CONDITIONS

E. John Felderman and James A. Albers Washington Feb. 1975 34 p refs

(NASA-TM-X-3194; E-8182) Avail: NTIS HC \$3.75 CSCL 20D

Comparisons between experimental and theoretical Mach number distributions and separation locations are presented for the internal surfaces of four different subsonic inlet geometries with exit diameters of 13.97 centimeters. The free stream Mach number was held constant at 0.127, the one-dimensional throat Mach number ranged from 0.49 to 0.71, and the incidence angle ranged from 0 deg to 50 deg. Generally good agreement was found between the theoretical and experimental surface Mach number distributions as long as no flow separation existed. At high incidence angles, where separation was obvious in the experimental data, the theory predicted separation on the lip. At lower incidence angles, the theoretical results indicated diffuser separation which was not obvious from the experimental surface Mach number distributions. As incidence angle was varied from 0 deg to 50 deg, the predicted separation location shifted from the diffuser region to the inlet highlight. Relatively small total

pressure losses were obtained when the predicted separation location was greater than 0.6 of the distance between the highlight and the diffuser exit. Author

N75-16510* Kanner (Leo) Associates, Redwood City, Calif.
AERODYNAMIC DESIGN OF AIRFOIL SECTIONS
 K. Uemaya, M. Omura, and T. Tanioka Washington NASA Feb. 1975 40 p refs Transl. into ENGLISH from Mitsubishi Juko Giho (Japan), v. 11, no. 2, 1974 p 1-12 (Contract NASw-2481)
 (NASA-TT-F-16141) Avail: NTIS HC \$3.75 CSCL 01A

The design of two dimensional subsonic airfoil sections is discussed. The NASA identification system for airfoil configurations is explained. The aerodynamic characteristics of various airfoil configurations are plotted in graph form. The two approaches to airfoil design are analyzed. The principal requirements in airfoil design for aerodynamic performance and geometric profile are identified. The application of wind tunnel tests to determine the characteristics of the airfoil is reported. Author

N75-16511* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL AERODYNAMICS CHARACTERISTICS FOR BODIES OF ELLIPTIC CROSS SECTION AT ANGLES OF ATTACK FROM 0 DEG TO 58 DEG AND MACH NUMBERS FROM 0.6 TO 2.0

Leland H. Jorgensen and Edgar R. Nelson Washington Feb. 1975 81 p refs Prepared in cooperation with ARO, Inc., Moffett Field, Calif.
 (NASA-TM-X-3129; A-5756) Avail: NTIS HC \$4.75 CSCL 01A

An experimental investigation was conducted to measure the static aerodynamic characteristics for two bodies of elliptic cross section and for their equivalent body of revolution. The equivalent body of revolution had the same length and axial distribution of cross-sectional area as the elliptic bodies. It consisted of a tangent ogive nose of fineness ratio 3 followed by a cylinder with a fineness ratio of 7. All bodies were tested at Mach numbers of 0.6, 0.9, 1.2, 1.5, and 2.0 at angles of attack from 0 deg to 58 deg. The data demonstrate that the aerodynamic characteristics can be significantly altered by changing the body cross section from circular to elliptic and by rolling the body from 0 deg to 90 deg. For example, the first elliptic body (with a constant cross-sectional axis ratio of 2) developed at zero roll about twice the normal force developed by the equivalent body of revolution. At some angles of attack greater than about 25 deg, side forces and yawing moments were measured in spite of the fact that the bodies were tested at zero angle of sideslip. The side-force and yawing-moment coefficients decreased with an increase in Mach number and essentially disappeared for all the bodies at Mach numbers greater than 1.2. From the standpoint of reducing undesirable side forces at high angles of attack, it is best to have the flattest side of the nose of the elliptic bodies pitching against the stream crossflow. The effect of Reynolds number was also the least significant for both elliptic bodies when the flattest side of the nose was pitched against the stream crossflow. Author

N75-16513* Scientific Translation Service, Santa Barbara, Calif.
EXPERIMENTAL TESTING OF UNSTEADY THREE-DIMENSIONAL LIFTING SURFACE THEORIES FOR INCOMPRESSIBLE FLOW

Horst Hertrich Washington NASA 28 Feb. 1975 108 p refs Transl. into ENGLISH of "Zur Experimentellen Pruefung Instationarer Dreidimensionaler Tragflaechentheorien bei Inkompressibler Stroemung", Rept. No. 40 Max Planck Inst. for Fluid Dynamics and the Aerodynamic Test Facility, 1967 p 1-114 (Contract NASw-2483)
 (NASA-TT-F-16200; Rept-40) Avail: NTIS HC \$5.25 CSCL 01A

Numerous pressure distribution measurements were made on harmonically oscillating rigid semiwing models with and without a rudder in order to experimentally test various unsteady lifting surface theories. The measurements were carried out with a

rectangular and a sweptback wing model with constant chord. The rudder chord was 30% of the wing chord. The model aspect ratios could be adjusted for side ratios. Investigations were carried out for pitch oscillations around various axes perpendicular to the incident flow direction and there were rudder rotational oscillations around the rudder leading edge. This was done at reduced frequencies as well as for the case where there was no incident flow (determination of air mass moving with the models). The measurement results were compared with a lifting surface method, a lifting line method, and the plane theory. Author

N75-16514* Scientific Translation Service, Santa Barbara, Calif.
CALCULATION OF THREE-DIMENSIONAL SUPERSONIC FLOWS PAST BODIES OF COMPLEX CONFIGURATION
 M. Ya. Ivanov and T. V. Nikitina Washington NASA 25 Feb. 1975 14 p refs Transl. into ENGLISH from Uch. Zap. (USSR), v. 4, 1973 p 7-13, A74-36852
 (Contract NASw-2483)

(NASA-TT-F-16192; A74-36852) Avail: NTIS HC \$3.25 CSCL 01A

The flow pattern of an aircraft model situated at an angle of attack in supersonic inviscid nonheat-conducting flow was analyzed. The steady state system of equations, written in the form of conservation laws, was integrated with the aid of a straightforward finite difference scheme developed for calculating two- and three-dimensional supersonic nozzle flows. A comparison with results obtained by the method of characteristics showed that the method employed is well suited for engineering calculations. Author

N75-16516* Aeronautical Research Inst. of Sweden, Stockholm, Aerodynamics Dept.
MEASUREMENTS OF STATIC STABILITY COEFFICIENTS OF AN OGIVE DELTA WING MODEL AT TRANSONIC AND SUPERSONIC SPEEDS

Goeran Ehn Feb. 1974 112 p refs
 (Contracts F-INK-11-12-0287; F-INK-07-11966/02871; F-INK-07-12615)
 (FFA-TN-AU-876) Avail: NTIS HC \$5.25

Wind tunnel measurements of an ogive delta wing model with 64.4 deg leading edge sweepback were carried out in a supersonic transonic 1 sq meter wind tunnel. Static and dynamic tests were carried out over a range of mach numbers from low transonic speed up to M 1.92, 3-5-, and 6-component strain gauge balance measurements and flow visualization tests were also performed. The angle of attack range includes angles at which vortex breakdown occurs. ESRO

N75-16517* Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.

WIND TUNNEL INVESTIGATIONS ON AN AIRPLANE MODEL WITH VARIABLE SWEEPBACK IN THE INCOMPRESSIBLE REGION. PART 2: PRESENTATION OF THE EVALUATED FORCE MEASUREMENTS Final Report [WINDKANALUNTERSUCHUNGEN AN EINEM FLUGZEUG-MODELL MIT VARIABLEM PFEILUNG IM INKOMPRESSIBLEN BEREICH. TEIL 2: ZUSAMMENSTELLUNG ALLER AUSGEWERTETEN KRAFTMESSUNGEN]

Dieter Schmitt 28 Jun. 1974 221 p refs In GERMAN Sponsored by Deut. Forschungsgemeinschaft (IFD-2/74-Pt-2) Avail: NTIS HC \$7.25

The influence was investigated of variation of wing sweep, pivot position, horizontal tail surface, angle of attack of the horizontal tail surface, body strake, and sideslip angle on the stationary aerodynamic coefficients of the lateral and longitudinal movement of an aircraft model. The force measurements are presented graphically. Flow diagrams are presented for various configurations of the model and at varied angles of attack, showing the influence of the strake-leading edge turbulence on the variable outer wing. ESRO

N75-16518* Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE PROBLEM OF PROPELLER/WING INTERFERENCE UP TO HIGH ANGLES OF ATTACK [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN ZUM PROBLEM DER PROPELLER-FLUEGEL-INTERFERENZ BIS ZU HOHEN ANSTELLWINKELN]

Bernd Straeter 20 Dec. 1973 181 p refs In GERMAN (IFD-5/73) Avail: NTIS HC \$7.00

Propeller-wing interactions for variable propeller modulus and variable propeller-wing distances were measured on a model during wind tunnel tests. Procedures for calculating wing coefficients and for the determination of the total force coefficients of propeller-wing configurations were developed. Theoretical procedures are in good agreement with experimental results.

ESRO

N75-16519# Saab-Scania, Linköping (Sweden). Aerospace Div.

APPLICATION OF THE POLAR COORDINATE METHOD TO OSCILLATING WING CONFIGURATIONS

Valter J. E. Stark [1973] 43 p refs Sponsored in part by Swed. Board for Tech. Develop. (SAAB-TN-69) Avail: NTIS HC \$3.75

A previously published method for the calculation of aerodynamic forces on oscillating wings with partial span control surfaces in subsonic flow by using polar integration variables was generalized and programmed in FORTRAN. The program can treat combinations of up to 10 trapezoidal surfaces with several control surfaces and tabs. The input data for the deflection modes may consist of measured values. These are treated by a subprogram that fits a function with suitable edge characteristics to the data for each mode. Numerical results are given for several configurations. Comparisons for simple modes with results of other methods show close agreement in most cases.

Author (ESRO)

N75-16520# National Physical Lab., Teddington (England). Aerodynamics Div.

SOME RESULTS OF WIND-TUNNEL TESTS ON AN AEROFOIL SECTION (NPL 9510) COMBINING A 'PEAKY' UPPER SURFACE-PRESSURE DISTRIBUTION WITH REAR LOADING

D. J. Hall, V. G. Quincey, and R. C. Lock London Aeron. Res. Council 1974 35 p refs Supersedes ARC-31312 (ARC-CP-1292; ARC-31312) Avail: NTIS HC \$3.75; HMSO 60p; PHI \$2.55

Experimental results are presented for an 11 percent thick airfoil, NPL 9510, designed to combine a region of shock-free supersonic flow over most of the upper surface with a substantial amount of rear loading. To alleviate adverse pressure gradients on the upper surface just ahead of the trailing edge, a 0.5 percent thick blunt-base was used. The design aims were principally achieved at Mach number equal 0.79 and C_{sub} equal 0.6. This represents at least a 10 percent increase in drag rise Mach number over a conventional section of the same thickness and lift coefficient. Separation margins at the design condition are very small and an undesirable drag creep appears at lower Mach numbers.

Author (ESRO)

N75-16521# Royal Aircraft Establishment, Farnborough (England) Structures Dept.

THE EFFECT OF STEADY TAILPLANE LIFT ON THE OSCILLATORY BEHAVIOUR OF A T-TAIL FLUTTER MODEL AT HIGH SUBSONIC SPEEDS

R. Gray and D. A. Drane London Aeron. Res. Council 1974 37 p refs Supersedes RAE-TR-71189; RAE-TR-72137; ARC-33863; ARC-34095 (ARC-R/M-3745; RAE-TR-71189; RAE-TR-72137; ARC-33863; ARC-34095) Avail: NTIS HC \$3.75; HMSO £1.45; PHI \$5.80

The oscillatory behavior of a T-tail was investigated at high subsonic Mach numbers on an aeroelastic model having tailplane settings of 0 and 3 deg. There is broadly satisfactory agreement between calculated and measured values of modal frequency and damping. The comparison was based mainly on the flutter

margin criterion of Zimmerman and Weissenburger, since the more conventional comparisons are inconclusive. Author (ESRO)

N75-16522# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WIND-TUNNEL TESTS ON SOME SLENDER AIRBUS CONFIGURATIONS

D. A. Kirby and A. G. Hepworth London Aeron. Res. Council 1974 57 p refs Supersedes RAE-TR-71216; ARC-33488 (ARC-R/M-3747; RAE-TR-71216; ARC-33488) Avail: NTIS HC \$4.25; HMSO £2.25; PHI \$8.72

An experimental investigation was made of the subsonic lift, drag, and longitudinal stability characteristics of models representing some alternative slender airbus configurations. For the same wing planform of aspect ratio 1.4 the lift, drag, and pitching moment were measured for two wings of maximum thickness/chord ratio 4 and 9%, respectively, both without and with various body arrangements. Trailing-edge controls were cut on the 4% wing, and the results were used to compare trimmed lift and drag coefficients for several alternative aircraft layouts. Included are the results of some tests with a foreplane which showed that considerable gains in usable lift coefficient and lift-drag ratio could be obtained with a high foreplane low wing configuration.

Author (ESRO)

N75-16523# European Space Research Organization, Paris (France).

CALCULATION OF THE EFFECTS OF PERMEABLE WALLS ON SUPERCRITICAL FLOW

Pierre Laval et al Oct. 1974 45 p refs Transl. into ENGLISH of Calcul des Effets de Paroi Permeable en Ecoulement Supercritique, ONERA-NT-211, Onera, 6 Mar. 1973 (ES O-TT-97; ONERA-NT-211) Avail: NTIS HC \$3.75

A time dependent method was developed to compute supercritical flow over an airfoil in a wind tunnel test section with perforated or solid walls. The time dependent equations of motion was calculated numerically by means of an explicit second order scheme. A parameter dependent on time and spatial variables was introduced under the term of artificial viscosity to assure the stability of the scheme. The perforated section of the wall is represented by a continuously permeable wall on which the relation of pressure jump to normal velocity component is given. The applications presented concern the calculations of supercritical flow over a biconvex airfoil and over the NACA 0012 airfoil at zero angle of attack for various values of the porosity parameter. The results obtained show that the present methods allow the wall permeability effects to be calculated and are in good agreement with the experimental data.

Author (ESRO)

N75-16524# European Space Research Organization, Paris (France).

EXPLICIT APPROXIMATE EQUATIONS FOR CALCULATING MACH NUMBER AND VARIOUS AIRSPEEDS

Werner Boegel Oct. 1974 29 p refs Transl. into ENGLISH of Explizite Naeherungsgleichungen zur Berechnung der Machzahl u. verschiedener Geschwindigkeiten, DLR-Mitt-74-08, DFVLR, 23 Jan. 1974

(ESRO-TT-100; DLR-Mitt-74-08) Avail: NTIS HC \$3.75; DFVLR, Porz, West Ger. 12.60 DM

Explicit approximation equations were derived for calculating the Mach number, airspeed, calibrated airspeed, and equivalent airspeed from pressures and temperatures measured in flight. Equations for the supersonic range were developed. These equations can be evaluated with the help of very simple digital computers. The error of these equations is for the most part below 0.1%.

Author (ESRO)

N75-16525# European Space Research Organization, Paris (France).

AUXILIARY FUNCTIONS OF THE THEORY FOR OSCILLAT-

ING LIFTING SURFACE OF HIGH ASPECT RATIO FOR MACH NUMBERS BETWEEN 0 AND 1. PART 1: ANALYTICAL REPRESENTATION

H. G. Kuessner Dec. 1974 32 p refs Transl. into ENGLISH of Hilfsfunktionen zur Theorie der Schwingenden Tragflaechen Grosseer Streckung im Bereich der Machschen Zahlen 0 bis 1. Teil 1: Anal. Darstellung. DLR-FB-73-16, DFVLR, 1973 (ES O-TT-111-Pt-1; DLR-FB-73-16) Avail: NTIS HC \$3.75; DFVLR, Porz, West Ger. 9.90 DM

Starting from the general linear three-dimensional integral equation of first kind of the unsteady lifting surface theory, an approximative theory of the oscillating lifting surface of large aspect ratio is derived for Mach numbers between 0 and 1. For this purpose three basic assumptions are introduced. The two-dimensional integral equation for the oscillating profile is applied. All auxiliary functions involved in this approximative theory are analytically presented in a rational form suitable for numerical calculations. Author (ESRO)

N75-16526# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.

DEVELOPMENT OF A MODEL TECHNIQUE FOR INVESTIGATING THE PERFORMANCE OF SOFT-GROUND ARRESTERS FOR AIRCRAFT

J. R. Barnes London Aeron. Res. Council 1974 50 p refs Supersedes RAE-TR-71231; ARC-34362 (ARC-CP-1275; RAE-TR-71231; ARC-34362) Avail: NTIS HC \$3.75; HMSO 80p; PHI \$3.25

The feasibility of using models to investigate the performance of gravel arresters for aircraft is discussed. The experiments were designed using the techniques of physical similarity and dimensional analysis. Tests were conducted with 1 to 9.3 scale models of Lightning and Canberra aircraft in two types of sand, and the results compared with those obtained in earlier full scale experiments. Results showed that the distance required to stop in gravel beds for a given entry speed could be predicted with an accuracy of plus or minus 10 to 15 percent.

Author (ESRO)

N75-16527# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

SOME PREDICTIONS OF CRACK PROPAGATION UNDER COMBINED CABIN PRESSURISATION AND ACOUSTIC LOADINGS

W. T. Kirkby London Aeron. Res. Council 1974 29 p refs Supersedes RAE-TR-73004; ARC-34641 (ARC-CP-1286; RAE-TR-73004; ARC-34641) Avail: NTIS HC \$3.75; HMSO 50p; PHI \$2.15

The effects of acoustic loading and pressurization cycling on the growth of a longitudinal crack in the pressure cabin of an aircraft are discussed. Results of the analysis show that the contribution to crack growth from acoustic loading may exceed that from pressure cycling, even though acoustic loading alone is not sufficiently severe to initiate fatigue damage. The requirement to account for acoustic loading when establishing the fail safe characteristics of structures is analyzed. Simplifying assumptions are made in the analysis and the need for additional research is stated. Author (ESRO)

N75-16528# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

AIRCRAFT ACCIDENT REPORTS. BRIEF FORMAT US CIVIL AVIATION ISSUE NUMBER 1 OF 1974 ACCIDENTS

6 Sep. 1974 552 p (PB-236867/8; NTSB-BA-74-4) Avail: NTIS HC \$13.00 CSCL 01B

Selected aircraft accident reports are presented in brief format, occurring in U.S. Civil Aviation operations during calendar year 1974. The 898 general aviation accidents contained represent a random selection. The publication is issued irregularly, normally six times each year. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by type of accident.

phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. GRA

N75-16530# Illinois Univ., Urbana.

SIMULATOR TESTS OF PILOTAGE ERROR IN AREA NAVIGATION WITH VERTICAL GUIDANCE: EFFECTS OF DESCENT ANGLE AND DISPLAY SCALE FACTOR Final Report, Nov. 1972 - Oct. 1973

Richard J. VanderKolk and Stanley N. Roscoe Oct. 1973 151 p refs

(Contract DOT-FA71WA-2574)

(AD-777889; ARL-73-13/FAA-73-2; FAA-RD-73-202) Avail: NTIS HC \$4.00 CSCL 17/7

Environmental and flight variables were systematically controlled to permit precise assessment of the effects on pilotage error of variations in vertical descent angle and vertical guidance display scale factor for each of two pilot groups representing different experience levels. Resulting flight profiles were less complex than those previously employed in that no course changes were required, thereby reducing the need for communications and inflight planning by the pilot. Pilot performance was measured in terms of altitude, cross-track, airspeed, and procedural errors and information processing rate on an independent side task. Altitude tracking errors increased with descent angle and decreased as display scale factor became more sensitive. Altitude errors for all level-flight conditions and for three-degree descents with sensitive scale factors were smaller than assumed in DO-152, whereas for steeper descents with insensitive scale factors they were larger. Altitude errors for all other conditions tested were not reliably different from values assumed in DO-152. Altitude errors for airline transport pilots were reliably smaller than for commercial instrument pilots for most of the experimental conditions tested. Author

N75-16533# TRW Systems Group, McLean, Va.

AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 2A: FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT Final Report, Nov. 1972 - Jan. 1974

F. Mertes, L. Jenney, and R. Jones Aug. 1974 201 p refs (Contract DOT-TSC-512)

(PB-236802/5; DOT-TSC-OST-74-14-2A) Avail: NTIS HC \$7.25; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

Volume 2 contains the analysis and description of air traffic management activities at three levels of detail functions, subfunctions, and tasks. A total of 265 tasks are identified and described, and the flow of information inputs and outputs among the tasks is specified. (Modified author abstract) GRA

N75-16534# TRW Systems Group, McLean, Va.

AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 2B: FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT (CONTINUED) Final Report, Nov. 1972 - Jan. 1974

F. Mertes Aug. 1974 256 p refs

(Contract DOT-TSC-512)

(PB-236803/3; DOT-TSC-OST-74-14-2B) Avail: NTIS HC \$8.50; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

N75-16535# TRW Systems Group, McLean, Va.

AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 2C: FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT (CONTINUED) Final Report, Nov. 1972 - Jan. 1974

F. Mertes, L. Jenney, and R. Jones Aug. 1974 192 p

(Contract DOT-TSC-512)

(PB-236804/1; DOT-TSC-OST-74-14-2C) Avail: NTIS HC \$7.00; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

N75-16536# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 2D: FUNCTIONAL ANALYSIS OF AIR TRAFFIC MANAGEMENT (CONCLUDED) Final Report, Nov. 1972 - Jan. 1974

F. Mertes Aug. 1974 222 p
 (Contract DOT-TSC-512)
 (PB-236805/8; DOT-TSC-OST-74-14-2D) Avail: NTIS HC \$7.25; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

N75-16537# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 3: METHODOLOGY FOR MAN-MACHINE TASK ALLOCATION Final Report, Nov. 1972 - Jan. 1974

F. Mertes and L. Jenny Aug. 1974 230 p refs
 (Contract DOT-TSC-512)
 (PB-236806/6; DOT-TSC-OST-74-14-3) Avail: NTIS HC \$7.50; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

Volume 3 describes the methodology for man-machine task allocation. It contains a description of man and machine performance capabilities and an explanation of the methodology employed to allocate tasks to human or automated resources. It also presents recommended allocations of tasks at five incremental levels of automation. (Modified author abstract) GRA

N75-16538# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 4A: AUTOMATION REQUIREMENTS Final Report, Nov. 1972 - Jan. 1974

F. Mertes and L. Jenney Aug. 1974 137 p
 (Contract DOT-TSC-512)
 (PB-236807/4; DOT-TSC-OST-74-14-4A) Avail: NTIS HC \$5.75; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET

A presentation of automation requirements is made for advanced air traffic management system in terms of controller work force, computer resources, controller productivity, system manning, failure effects, and control/display requirements. It also includes a discussion of the application of the study results to the design and development of AATMS. GRA

N75-16539# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 4B: AUTOMATION REQUIREMENTS (CONCLUDED) Final Report, Nov. 1972 - Jan. 1974

F. Mertes and L. Jenney Aug. 1974 220 p refs
 (Contract DOT-TSC-512)
 (PB-236808/2; DOT-TSC-OST-74-14-4B) Avail: NTIS HC \$7.25; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

N75-16540# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 5A: DELTA SIMULATION MODEL USER'S GUIDE Final Report, Nov. 1972 - Jan. 1974

F. Mertes, K. Willis, and E. C. Barkley Aug. 1974 192 p
 (Contract DOT-TSC-512)
 (PB-236809/0; DOT-TSC-OST-74-14-5A) Avail: NTIS HC \$7.00; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

The DELTA Simulation Model is described. It includes all documentation of the DELTA (Determination Effective Levels of

Task Automation) computer simulation for use in the Automation Applications Study. Volume 5A includes a user's manual, test case, and test case results. Volume 5B includes a programmer's manual. (Modified author abstract) GRA

N75-16541# TRW Systems Group, McLean, Va.
AUTOMATION APPLICATIONS IN AN ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM. VOLUME 5B: DELTA SIMULATION MODEL PROGRAMMER'S GUIDE Final Report, Nov. 1972 - Jan. 1974

F. Mertes, K. Willis, and E. C. Barkley Aug. 1974 150 p
 (Contract DOT-TSC-512)
 (PB-236810/8; DOT-TSC-OST-74-14-5B) Avail: NTIS HC \$5.75; HC also available from NTIS \$59.00/set of 10 reports as PB-236800-SET CSCL 17G

N75-16542*# Grumman Aerospace Corp., Bethpage, N.Y.
EFFECTS OF SEVERAL FACTORS ON THEORETICAL PREDICTIONS OF AIRPLANE SPIN CHARACTERISTICS
 William Bihle, Jr. and Billy Barnhart Aug. 1974 277 p refs
 (Contract NAS1-12519)
 (NASA-CR-132521) Avail: NTIS HC \$8.75 CSCL 01C

The influence of different mathematical and aerodynamic models on computed spin motion was investigated along with the importance of some of the aerodynamic and nonaerodynamic quantities defined in these models. An analytical technique was used which included the aerodynamic forces and moments acting on a spinning aircraft due to steady rotational flow and the contribution of the rotary derivatives to the oscillatory component of the total angular rates. It was shown that (1) during experimental-analytical correlation studies, the flight-recorded control time histories must be faithfully duplicated since the spinning motion can be sensitive to a small change in the application of the spin entry controls; (2) an error in the assumed inertias, yawing moments at high angle of attack, and initial spin entry bank angle do not influence the developed spin significantly; (3) damping in pitch derivatives and the center of gravity location play a role in the spinning motion; and (4) the experimental spin investigations conducted in a constant atmospheric density environment duplicate the Froude number only at the initial full-scale spin altitude (since the full-scale airplane at high altitudes experiences large density changes during the spin.) Author

N75-16543*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

EFFECT OF SYMMETRICAL VORTEX SHEDDING ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF WING-BODY-TAIL COMBINATIONS Final Report

Michael R. Mendenhall and Jack N. Nielsen Washington NASA Jan. 1975 119 p refs
 (Contract NAS2-7347)
 (NASA-CR-2473) Avail: NTIS HC \$5.25 CSCL 01A

An engineering prediction method for determining the longitudinal aerodynamic characteristics of wing-body-tail combinations is developed. The method includes the effects of nonlinear aerodynamics of components and the interference between components. Nonlinearities associated with symmetrical vortex shedding from the nose of the body are considered as well as the nonlinearities associated with the separation vortices from the leading edges and side edges of the lifting surfaces. The wing and tail characteristics are calculated using lifting surface theories which include effects of incidence, camber, twist, and induced velocities from external sources of disturbance such as bodies and vortices. The lifting surface theories calculate the distribution of leading edge and side edge suction which is converted to vortex lift using the Polhamus suction analogy. Correlation curves are developed to determine the fraction of the theoretical suction force which is converted into vortex lift. The prediction method is compared with experimental data on a variety of aircraft configurations to assess the accuracy and limitations of the method. Author

N75-16544 *# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A FREE FLIGHT INVESTIGATION OF TRANSONIC STING INTERFERENCE

Peter Jaffe 1 Jan. 1975 48 p refs

(Contract NAS7-100)

(NASA-CR-142084; JPL-TM-33-704) Avail: NTIS HC \$3.75 CSCL 01C

Transonic sting interference has been studied in a supersonic wind tunnel to obtain free flight and sting support data on identical models. The two principal configurations, representing fuselage bodies, were cigar shaped with tail fins. The others were a sharp 10-deg cone, a sphere, and a blunt entry body. Comparative data indicated that the sting had an appreciable effect on drag for the fuselage-like configurations; drag rise occurred 0.02 Mach number earlier in free flight, and drag level was 15% greater. The spheres and the blunt bodies were insensitive to the presence of stings regardless of their size. The 10-deg cones were in between, experiencing no drag difference with a minimum diameter sting, but a moderate difference with the largest diameter sting tested. All data tend to confirm the notion that for the more slender bodies the sting not only affects flow but the forebody flow as well. Author

N75-16545 # National Aviation Facilities Experimental Center, Atlantic City, N.J.

SIMULATED GROUND-LEVEL STOL RUNWAY/AIRCRAFT EVALUATION. PHASE 3: TESTS Final Report, Jun. - Jul. 1973

Roman M. Spangler, Jr. Aug. 1974 49 p refs

(FAA Proj. 183-591-010)

(AD-783749; FAA-RD-74-96; FAA-NA-73-98) Avail: NTIS HC \$3.25

A De Havilland DHC-6 Series 100 Twin Otter was flown by five pilots of varied experience on 7.5 deg steep-gradient approaches onto a ground-level STOL runway. Forty (40) approaches and landings were accomplished using an angle-of-attack indicator (airspeed indicator blocked out) as primary speed control. Pilot performance as compared to performance with the airspeed indicator as primary speed control was slightly improved. A series of 6 deg steep approaches was made in simulated certification landing tests with dry and wet runways at various water depths. Runway friction, stopping, and landing distances were measured, and stopping distance ratios are shown. Maximum vertical touchdown velocities on steep approaches were also evaluated. Author

N75-16546 *# Boeing Co., Wichita, Kans.

REQUIREMENTS AND FEASIBILITY STUDY OF FLIGHT DEMONSTRATION OF ACTIVE CONTROLS TECHNOLOGY (ACT) ON THE NASA 515 AIRPLANE

C. K. Gordon Jan. 1975 147 p refs

(Contract NAS1-13061)

(NASA-CR-132555) Avail: NTIS HC \$5.75 CSCL 01C

A preliminary design study was conducted to evaluate the suitability of the NASA 515 airplane as a flight demonstration vehicle, and to develop plans, schedules, and budget costs for fly-by-wire/active controls technology flight validation in the NASA 515 airplane. The preliminary design and planning were accomplished for two phases of flight validation. Author

N75-16547 *# Mechanics Development Co., Pacific Palisades, Calif.

MEASUREMENTS OF V/STOL AIRCRAFT NOISE MECHANISMS USING PRESSURE CROSS-CORRELATION TECHNIQUES IN A REVERBERANT WIND TUNNEL Final Report

W. C. Meecham and P. M. Hurdle 31 Oct. 1974 78 p refs (Contract NAS2-7346)

(NASA-CR-137627) Avail: NTIS HC \$4.75 CSCL 01B

A 3.8 cm. model jet was operated in a wind tunnel with cross-flow in order to determine the effect on jet noise radiated characteristics. A method was developed for the determination of noise radiating characteristics of sources within reverberant wind tunnels; cross-correlation measurements were used. The averaging time in the cross-correlation is determined by the amount of background noise within the wind tunnel. It was

found that cross-flow increases the radiated noise by 10 db. There was some indication of downstream radiation exceeding the sideline radiation. Author

N75-16548 *# Kanner (Leo) Associates, Redwood City, Calif.
GLIDERS AND THE ART OF GLIDING

V. M. Zamyatin Washington NASA Mar. 1975 249 p refs Transl. into ENGLISH of the book "Planery i Planerizm" Moscow, Mashinostroyeniye Press, 1974 p 1-248

(Contract NASw-2481)

(NASA-TT-F-16104) Avail: NTIS HC \$7.50 CSCL 01C

The aerodynamics, stability, controllability and structural strength of gliders are described. Design and structural materials are discussed, and safety and reliability as well. Glider flight at large angles of attack and in spin are covered in detail. A history of gliders and pilot-training on gliders is reported. The author considers that gliding is an independent field of aviation which has an important contribution to make to the field as a whole. Further development of glider construction is examined, to meet flights of greater distance, higher altitude, and greater speed. Author

N75-16549 # Aeronautical Research Labs., Melbourne (Australia).
DOVE WING FATIGUE TEST

R. Ellis, D. G. Graff, and B. J. Mitchell May 1974 60 p refs (ARL/SM-Note-408) Avail: NTIS HC \$4.25

A pair of De Havilland 104 wings was tested to obtain the fatigue life of the splice in the main spar tension boom resulting from the incorporation of modification 780, and the overall fatigue characteristics of the wing. The calculated fatigue life for the splice was 65,580 hours. Failure of the main spar tension boom, three inches outboard from the end of the splice, occurred at a total life of 136,740 hours. During the test a number of fatigue cracks were obtained, the majority of a minor nature. These cracks were allowed to grow under surveillance before repair schemes were undertaken to enable testing to continue. Author

N75-16550 # Aeronautical Research Labs., Melbourne (Australia).
FATIGUE TESTING OF DH 104 DOVE CENTRE SECTION TENSION BOOMS

R. Ellis and D. G. Graff Jun. 1974 32 p refs

(ARL/SM-Note-409) Avail: NTIS HC \$3.75

A fatigue test was carried out on a pair of De Havilland 104 'Dove' wings which were subjected to a 5 level programmed loading representing a West Australian flight spectrum and a ground to air cycle. A resonant vibration technique was used to determine the fatigue life of a splice and the overall fatigue characteristics of the outer wings. During the test, fatigue cracks occurred in the center section boom member and were allowed to propagate under surveillance. When the crack propagation rate increased significantly, and there was a likelihood of complete boom failure, a new boom was fitted. M.J.S.

N75-16551 *# Bell Aerospace Co., Buffalo, N.Y.
INTERNAL CONVECTIVE COOLING SYSTEMS FOR HYPERSONIC AIRCRAFT Final Report

F. M. Anthony, W. H. Dukes, and R. G. Helenbrook Washington NASA Feb. 1975 44 p refs

(Contract NAS1-11357)

(NASA-CR-2480) Avail: NTIS HC \$3.75 CSCL 01C

Parametric studies were conducted to investigate the relative merits of construction materials, coolants, and cooled panel concepts for internal convective cooling systems applied to airframe structures of hydrogen-fueled hypersonic aircraft. These parametric studies were then used as a means of comparing various cooled structural arrangements for a hypersonic transport and a hypersonic research airplane. The cooled airplane studies emphasized weight aspects as related to the choice of materials, structural arrangements, structural temperatures, and matching of the cooling system heat load to the available hydrogen fuel-flow heat sink. Consideration was given to reliability and to fatigue and fracture aspects, as well. Even when auxiliary thermal protection system items such as heat shielding, insulation, and excess hydrogen for cooling are considered the more attractive actively cooled airframe concepts indicated potential payload increases of from 40 percent to over 100 percent for the

hypersonic transport as compared to the results of previous studies of the same vehicle configuration with an uncooled airframe.

Author

N75-16552# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

ASYMMETRIC WING LOADS ON A CANBERRA AIRCRAFT DURING FLIGHT IN TURBULENCE

J. P. Thompson London Aeron. Res. Council 1974 28 p refs Supersedes RAE-TR-72164; ARC-34296 (ARC-CP-1270; RAE-TR-72164; ARC-34296) Avail: NTIS HC \$3.75; HMSO 45p; PHI \$1.95

A study was conducted of the asymmetric load on the wing of a Canberra aircraft under turbulent conditions. The asymmetric part is separated from the symmetric part as far as is possible with the available data. The relationship of the asymmetric part to the rolling acceleration is analyzed. Author (ESRO)

N75-16553# Queen Mary Coll., London (England). Dept. of Aeronautical Engineering.

ANALYSIS OF FLIGHT AND TUNNEL TESTS ON THE FAIREY DELTA 2 RESEARCH AIRCRAFT

R. A. Feik Aeron. Res. Council 1974 85 p refs Supersedes ARC-33992

(ARC-R/M-3738; ARC-33992) Avail: NTIS HC \$4.75; HMSO £3.30; PHI \$12.89

A detailed comparison of results was made from several series of flight tests, spanning a number of years, on the Fairey Delta 2, with wind tunnel tests on 1/9 and 1/24 scale models and with reference also to simple theoretical results. The Mach number range of interest has been $M = 0.6$ to $M = 1.8$. Both longitudinal and lateral characteristics are considered, together with flow field development and surface pressure measurements. In order to help explain several discrepancies observed, special interest was focused on detailed differences in geometry between full scale aircraft and models, on aeroelastic effects, and on differences in flow field development due to scale differences. It has been possible to suggest explanations for many of the discrepancies in terms of these effects. Where possible, reference has been made to other similar aircraft in order to make the conclusions as general as possible. Author (ESRO)

N75-16554*# Decision Sciences Corp., Jenkintown, Pa.

ANALYSIS OF TECHNOLOGY REQUIREMENTS AND POTENTIAL DEMAND FOR GENERAL AVIATION AVIONICS SYSTEMS FOR OPERATION IN THE 1980'S Executive Summary

David M. Cohn, John H. Kayser, George M. Senko, and Donald R. Glenn Jun. 1974 35 p

(Contract NAS2-7888)

(NASA-CR-137628) Avail: NTIS HC \$3.75 CSCL 01D

Avionics systems are identified which promise to reduce economic constraints and provide significant improvements in performance, operational capability and utility for general aviation aircraft in the 1980's. Author

N75-16556# National Aviation Facilities Experimental Center, Atlantic City, N.J.

JET ENGINE BURN-THROUGH FLAME CHARACTERISTICS Final Report, Jan. - Sep. 1973

Richard Hill Jul. 1974 37 p refs

(FAA Proj. 181-522-010)

(AD-781795; FAA-NA-74-7; FAA-RD-74-19) Avail: NTIS HC \$3.25

Tests were run to determine the effect of the angle and radius of curvature of a firewall, with respect to a burnthrough flame, on burnthrough time. No difference was noted in burnthrough time for angles of zero-, 10-, or 20-degrees. A slight increase was noted at 30 degrees, and at 40 degrees no burn-through occurred. No great difference in burnthrough time was noted with a change in the curvature of the firewall. Centerline flatplate impingement pressures and temperatures were measured

and graphed for burnthroughs having pressure ratios of 11:1, 9:1, 6:1, and 4:1, and hole sizes of 1, 1.5, and 2 inches. The exit velocity, density, and mass flow rate were also calculated for those flames. The radial flatplate impingement profile was mapped for an 11:1 pressure ratio flame from a 1.5-inch hole. Flame characteristics of 16:1, 20:1, and 25:1 pressure ratio burnthroughs were estimated. Author

N75-16557*# Lockheed Aircraft Corp., Burbank, Calif.

EVALUATION OF ADVANCED LIFT CONCEPTS AND POTENTIAL FUEL CONSERVATION FOR SHORT-HAUL AIRCRAFT

H. S. Sweet, J. H. Renshaw, and M. K. Bowden Washington NASA Feb. 1975 93 p refs

(Contract NAS2-6995)

(NASA-CR-2502) Avail: NTIS HC \$4.75 CSCL 01C

The effect of different field lengths, cruise requirements, noise level, and engine cycle characteristics on minimizing fuel consumption and minimizing operating cost at high fuel prices were evaluated for some advanced short-haul aircraft. The conceptual aircraft were designed for 148 passengers using the upper surface-internally blown jet flap, the augmentor wing, and the mechanical flap lift systems. Advanced conceptual STOL engines were evaluated as well as a near-term turbofan and turboprop engine. Emphasis was given to designs meeting noise levels equivalent to 95-100 EPNdB at 152 m (500 ft) sideline. Author

N75-16559*# General Electric Co., Cincinnati, Ohio.

QCSEE TASK 2: ENGINE INSTALLATION PRELIMINARY DESIGN Final Report An Early Dissemination Report

R. E. Neitzel, R. Lee, and A. J. Chamay Jun. 1973 350 p

(Proj. FEDD; Contract NAS3-16726)

(NASA-CR-134738) Avail: NASA Industrial Applications Centers only to U. S. Requesters: HC \$9.50/MF \$2.25 CSCL 21E

The results of a preliminary design effort for four high-pass turbofan engines with features required for commercial short haul, powered lift transport aircraft are presented. Two engines were configured for each of the externally blown flap installations (under the wing and over the wing). Estimates of installed and uninstalled performance, noise, and weight are defined for each propulsion system. Block diagrams of the systems and graphs of the performance data are provided. Author

N75-16560*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

ANALYSIS OF LONGITUDINAL PILOT-INDUCED OSCILLATION TENDENCIES OF YF-12 AIRCRAFT

John W. Smith and Donald T. Berry Washington Feb. 1975 40 p refs

(NASA-TN-D-7900; H-805) Avail: NTIS HC \$3.75 CSCL 01C

Aircraft flight and ground tests and simulator studies were conducted to explore pilot-induced oscillation tendencies. Linear and nonlinear calculations of the integrated flight control system's characteristics were made to analyze and predict the system's performance and stability. The investigations showed that the small-amplitude PIO tendency was caused by the interaction of the pilot with a combination of the aircraft's short-period poles and the structural first bending mode zeros. It was found that the large-amplitude PIO's were triggered by abrupt corrective control actions by the pilot, which caused the stability augmentation system servo to position and rate limit. The saturation in turn caused additional phase lag, further increasing the tendency of the overall system to sustain a PIO. Author

N75-16561*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

APPLICABILITY OF RANDOMDEC TECHNIQUE TO FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT

Robert E. Reed, Jr. and Henry A. Cole, Jr. Jan. 1975 34 p refs

(Contract NAS2-8325)

(NASA-CR-137609; NEAR-TR-80) Avail: NTIS HC \$3.75 CSCL 14B

The feasibility of Randomdec analysis to detect certain changes in a flight simulator system is studied. Results show that (1) additional studies are needed to ensure effectiveness; (2) a trade-off exists between development complexity and level of malfunction to be detected; and (3) although the system generally limits the input signals to less than about 5 Hz, higher frequency components in the range of 9 Hz and its harmonics are possible. Author

N75-16565# Ohio Univ., Athens. Dept. of Electrical Engineering.

INSTRUMENT LANDING SYSTEM IMPROVEMENT PROGRAM: CENTERLINE MONITOR Final Report

Patrick H. Garrett and Robert A. Rondini May 1974 58 p refs

(Contract DOT-FA69WA-2066)

(AD-781797; FAA-RD-74-89; EER-5-16) Avail: NTIS HC \$3.75

Results of a study to investigate techniques for assuring Category 3 localizer signal integrity for roll-out guidance indicate that a surveillance method supported by sterilization of specific areas on and near the runway and quality near and farfield monitoring provide the best tradeoff between quality control and practical implementation. A precision, portable localizer detector to provide accuracies of 0.0005 DDM needed for assessing localizer signal quality with respect to ICAO 0.005 DDM standards has been designed, built, and successfully tested. Author

N75-16566# Rome Air Development Center, Griffiss AFB, N.Y. **FAA LIGHTNING PROTECTION STUDY: LIGHTNING PROTECTION REQUIREMENTS FOR AN/GRN-27 (V) INSTRUMENT LANDING SYSTEM Final Report, Nov. 1972 - 31 Jan. 1974**

Gene K. Huddleston, John D. Nordgard, and Ronald Larson Apr. 1974 120 p refs

(Contract DOT-FA72WAI-356)

(AD-785859; FAA-RD-74-131) Avail: NTIS HC \$7.50

The withstand capabilities and protection requirements for solid state circuits of the AN/GRN-27 (V) Instrument Landing System susceptible to lightning-induced transients on buried control cables are presented. Susceptible circuits and components were identified from the wiring diagrams as transistors, diodes, relay contacts, and electrolytic capacitors. Withstand capabilities of each circuit were determined analytically using manufacturer's data and a 1000-volt, 10 x 1000 microsecond test waveform. Avalanche diode surge protectors and series resistance are recommended to protect susceptible circuits from lightning-induced transients on buried control cable conductors connected to the circuits. Author

N75-16577# Modern Army Selected Systems Test Evaluation and Review, Fort Hood, Tex.

AIRCRAFT MAINTENANCE TRAILER SYSTEM Final Report, 28 Oct. 1973-10 Jun. 1974

Kenneth W. Allen 20 Sep. 1974 30 p

(AD-786553; MASSTER-Test-FM-1958) Avail: NTIS CSCL 01/5

The user evaluation to confirm the effectiveness of the standard aircraft maintenance trailer system and four prototype adapters was conducted at MASSTER, Fort Hood, Texas, from 28 Oct 73 to 10 Jun 74. The trailer system and prototype adapters were evaluated at aviation unit level with integrated direct support maintenance (IDSM) where they were used to build up and transport large aircraft components. The trailer system, the transmission and rotor hub adapter, and the rotor blade adapter were effective. The AH-IG rotor hub adapter was effective for transport only. The propeller adapter was ineffective. Author (GRA)

N75-16636# National Materials Advisory Board, Washington, D.C.

METAL-MATRIX COMPOSITES: STATUS AND PROSPECTS

Dec. 1974 117 p refs Sponsored by NASA

(Contract MDA903-74-C-0167)

(NASA-CR-142191; NMAB-313) Avail: NTIS HC \$5.25 CSCL 11D

Applications of metal matrix composites for air frames and jet engine components are discussed. The current state of the art in primary and secondary fabrication is presented. The present and projected costs were analyzed to determine the cost effectiveness of metal matrix composites. The various types of metal matrix composites and their characteristics are described. Author

N75-16637# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

STUDY OF THE COSTS AND BENEFITS OF COMPOSITE MATERIALS IN ADVANCED TURBOFAN ENGINES Final Report, 27 Jun. - 27 Dec. 1973

C. A. Steinhagen, C. L. Stotler, and R. E. Neitzel Oct. 1974 194 p refs

(Contract NAS3-17775)

(NASA-CR-134696; R74AEG418) Avail: NTIS HC \$7.00 CSCL 11D

Composite component designs were developed for a number of applicable engine parts and functions. The cost and weight of each detail component was determined and its effect on the total engine cost to the aircraft manufacturer was ascertained. The economic benefits of engine or nacelle composite or eutectic turbine alloy substitutions was then calculated. Two time periods of engine certification were considered for this investigation, namely 1979 and 1985. Two methods of applying composites to these engines were employed. The first method just considered replacing an existing metal part with a composite part with no other change to the engine. The other method involved major engine redesign so that more efficient composite designs could be employed. Utilization of polymeric composites wherever payoffs were available indicated that a total improvement in Direct Operating Cost (DOC) of 2.82 to 4.64 percent, depending on the engine considered, could be attained. In addition, the percent fuel saving ranged from 1.91 to 3.53 percent. The advantages of using advanced materials in the turbine are more difficult to quantify but could go as high as an improvement in DOC of 2.33 percent and a fuel savings of 2.62 percent. Typically, based on a fleet of one hundred aircraft, a percent savings in DOC represents a savings of four million dollars per year and a percent of fuel savings equals 23,000 cu m (7,000,000 gallons) per year. Author

N75-16741# Communications Research Centre, Ottawa (Ontario).

A LIGHT AIRCRAFT SECONDARY RADAR TRANSPONDER

W. D. Hindson, D. C. Barnes, F. R. Cross, N. R. Fines, R. H. Martin, A. L. Poirier, and G. M. Royer Jun. 1973 73 p refs (DRB Proj. 38-01-50)

(CRC-1237; DRB-TELS-17) Avail: NTIS HC \$4.25

A secondary radar transponder was fabricated as part of a feasibility test of a concept for increasing flight safety near airports by the mandatory use of low-powered transponders on all light aircraft. A detailed description is provided of the design and fabrication of the all-solid-state developmental transponder. Seven flight trials of the equipment support the conclusion that a low-powered transponder would greatly reduce the light aircraft problem near airports. Author

N75-16742# Philco-Ford Corp., Willow Grove, Pa. Communication Systems Div.

FAA PRINTED CIRCUIT BOARD ANALYSIS: COMPREHENSIVE ANALYSIS Final Report, task 1C

Gerald L. Ginsberg Dec. 1973 83 p refs

(Contract DOT-FA72WAI-3000)

(AD-781798; FAA-RD-74-109) Avail: NTIS HC \$4.00

Based on the results of the data collected on FAA printed circuit boards the effect was investigated of standard printed circuit board size requirements on existing FAA equipment. The analysis takes into account FAA maintenance and logistic systems. It was found that significant benefits can be accrued if parameters, in addition to the board size, are properly standardized and applied. Author

N75-16833 Army Electronics Command, Fort Monmouth, N.J.
THE APPLICATION OF LASERS TO THE PROBLEMS OF VERY LOW LEVEL FLIGHT OBSTACLE AVOIDANCE AND TERRAIN FOLLOWING

C. M. Kellington *In* AGARD Evaluation of the Potential Benefit to the Aeron. Field from Laser Technol. Dec. 1974 9 p refs

Lasers have found application in helping to solve the problems of very low level flight by U.S. Army aircraft. In the following is discussed: the reasons why Army aircraft fly low, the nature of the operational problems encountered at low altitudes, the technical problems associated with the design of systems to enhance low level flight capability, research efforts to date directed toward solution of the problem of low level flight and finally a comparison of the capabilities of microwave and laser systems in this area. The limitations of laser systems and research areas still requiring investigation are also discussed. Author

N75-16841 Compagnie Generale d'Electricite, Marcoussis (France). Section Electronique et Photonique.

OPTICAL FIBER COMMUNICATION ONBOARD AIRCRAFT [COMMUNICATIONS PAR FIBRES OPTIQUES A BORD D'AVIONS]

J. Ernest *In* AGARD Evaluation of the Potential Benefit to the Aeron. Field from Laser Technol. Dec. 1974 11 p refs *In* FRENCH; ENGLISH summary

Recent advances in optical fiber transmission and their potential use in some specific areas are reported. These advances include: different types of low pass optical fibers, single mode clad glass fibers, multimode clad glass fibers, multimode clad liquid core clad fibers and SELFOC glass fibers. Important components of an optical fiber link, mostly light emitters, are examined along with tradeoffs and possible combinations of components for specific system applications. Advantages of optical fiber transmission are discussed with emphasis on features related specifically to communication link problems with an aircraft. Author

N75-16842 Service Technique des Telecommunications de l'Air, Paris (France).

CONCLUSIONS AND RECOMMENDATIONS [CONCLUSIONS ET RECOMMANDATIONS]

J. Bertrais *In* AGARD Evaluation of the Potential Benefit to the Aeron. Field from Laser Technol. Dec. 1974 7 p *In* FRENCH

Recommendations regarding the feasibility, use, and applications of various laser types and laser systems in aerospace are given. Special attention was given to tracking studies, communication, surveillance and reconnaissance onboard aircraft, and image storage techniques. Transl. by E.H.W.

N75-16880# ASE, Inc., Pennsauken, N.J.
DEVELOPMENT AND TEST OF LOW IMPACT RESISTANCE STRUCTURES. VOLUME 1: STRUCTURAL AND DYNAMIC ASPECTS Final Report, Phase 1

Robert W. Harralson, Charles W. Laible, and John Lazarin Feb. 1974 165 p

(Contract DOT-FA72WA-3043)

(AD-783185; FAA-RD-73-187-1-Vol-1) Avail: NTIS HC \$5.00

A breakaway pole has been designed and developed and tested to satisfy the requirements for a frangible light support structure. This pole consists of four tapered sections and one straight section assembled to form a unitary structure approximately 20 feet high. The basic structure is shown by analysis to satisfy the requirements for survival in a 75 mph wind with 1/2 in. of radial ice, and a 100 mph wind with no radial ice, with factors of safety of 4.3 and 3.2 respectively. Deflection under a 45 mph wind is 0.6 of the allowable value. Tests of the joints in the pole were performed to optimize the pole performance. An impact test using an instrumented impactor was designed and developed under this contract. Utilizing the impactor mounted on a catapult carriage at the NASA Langley Research Center, the newly developed pole is shown to exhibit frangibility superior to other structures currently in use by factors ranging from 2.5 to 10.0. Author

N75-16977# Advisory Group for Aerospace Research and Development, Paris (France).

THE 1974 AGARD ANNUAL MEETING: THE ENERGY PROBLEM: IMPACTS ON MILITARY RESEARCH AND DEVELOPMENT

Dec. 1974 84 p refs *In* ENGLISH and partly in FRENCH Meeting held at Paris, 26 Sep. 1974

Avail: NTIS HC \$4.75

The proceedings of a conference on the impact of the energy problem on military research and development projects are presented. Some of the subjects discussed are as follows: (1) energy problems in a global context, (2) energy related research and development in the U.S. Air Force, (3) alternate fuels for aviation purposes, (4) the impact of future fuels on military aircraft engines, and (5) energy resources and utilization.

N75-16979 Air Force Dept., Washington, D.C.

ENERGY-RELATED RESEARCH AND DEVELOPMENT IN THE UNITED STATES AIR FORCE

Michael I. Yarymovych *In* AGARD The 1974 AGARD Ann. Meeting Dec. 1974 p 21-30

The requirements for petroleum based energy sources by the Department of Defense of the United States are analyzed. In addition to the requirements of the military forces, the logistic requirements are also examined. The impact of the energy crisis on military research and development programs to develop new energy sources for military use is examined. Methods of reducing fuel consumption by aircraft design and structural modification are proposed. The effectiveness of a campaign to reduce energy requirements and expenditures is documented. Author

N75-16980 Pinkel (I. Irving), Fairview Park, Ohio.

ALTERNATIVE FUELS FOR AVIATION

I. Irving Pinkel *In* AGARD The 1974 AGARD Ann. Meeting Dec. 1974 p 31-36

CSCL 21D

The status of energy programs to provide hydrocarbon fuels from new sources is examined. Experience in the United States with non-hydrocarbon fuels for turbine powered aircraft is analyzed. The various alternate sources of hydrocarbon fuels are defined. The use of metals and metal slurries as turbine fuels is proposed. The advantages and disadvantages of liquid hydrogen as an aircraft fuel are discussed. A specific example of an aircraft operating on liquid hydrogen is described. Author

N75-16981 National Aerospace Lab., Amsterdam (Netherlands).
IMPACT OF FUTURE FUELS ON MILITARY AERO-ENGINES

F. Jaarsma *In* AGARD The 1974 AGARD Ann. Meeting Dec. 1974 p 37-46 refs

The expected impact of the fossil fuel shortage on the design and operation of aircraft engines is discussed. Alternate fuels such as cryogenic fluids and synthetic fuels are proposed. Various aspects related to combustion of cryogenic and synthetic fuels are analyzed to examine the effects on seals, pumps, contamination, and engine operating procedures. Author

N75-16982 Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.

IMPACT ON AERODYNAMIC DESIGN

X. Hafer In AGARD The 1974 AGARD Ann. Meeting Dec. 1974 p 47-55 refs

The impact of fossil fuel consumption and anticipated shortages on aircraft design for improved efficiency is examined. Aerodynamic possibilities for improved efficiency are as follows: (1) aerodynamic configuration optimization, (2) boundary layer suction, (3) the oblique wing, and (4) supercritical airfoils. Aerodynamic improvements using active controls are as follows: (1) relaxed static stability, (2) maneuver load control, (3) active flutter control, and (4) gust alleviation and fatigue damage control. Changes in aircraft aerodynamics design resulting from the use of hydrogen fuel are analyzed. Author

N75-17011** Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

AIR POLLUTION FROM FUTURE GIANT JETPORTS

James A. Fay May 1970 13 p refs

(Grant NGR-22-009-378)

(NASA-CR-142165) Avail: NTIS HC \$3.25 CSCL 13B

Because aircraft arrive and depart in a generally upwind direction, the pollutants are deposited in a narrow corridor extending downwind of the airport. Vertical mixing in the turbulent atmosphere will not dilute such a trail, since the pollutants are distributed vertically during the landing and take-off operations. As a consequence, airport pollution may persist twenty to forty miles downwind without much attenuation. Based on this simple meteorological model, calculations of the ambient levels of nitric oxide and particulates to be expected downwind of a giant jetport show them to be about equal to those in present urban environments. These calculations are based on measured emission rates from jet engines and estimates of aircraft performance and traffic for future jetports. Author

N75-17012** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHOD OF REPRESENTATION OF ACOUSTIC SPECTRA AND REFLECTION CORRECTIONS APPLIED TO EXTERNALLY BLOWN FLAP NOISE

Jeffrey H. Miles Washington Feb. 1975 69 p refs

(NASA-TM-X-3179; E-8043) Avail: NTIS HC \$4.25 CSCL 20A

A computer method for obtaining a rational function representation of an acoustic spectrum and for correcting reflection effects is introduced. The functional representation provides a means of compact storage of data and the nucleus of the data analysis method. The method is applied to noise from a full-scale externally blown flap system with a quiet 6:1 bypass ratio turbofan engine and a three-flap wing section designed to simulate the take-off condition of a conceptual STOL aircraft. Author

N75-17154** United Aircraft Corp., East Hartford, Conn. Research Labs.

INVESTIGATION OF SCRUBBING AND IMPINGEMENT NOISE

Martin R. Fink Washington NASA Feb. 1975 153 p refs (Contract NAS3-17863)

(NASA-CR-134762) Avail: NTIS HC \$6.25 CSCL 20A

Tests were conducted in an acoustic wind tunnel to determine surface pressure spectra and far field noise caused by turbulence impinging on an airfoil and turbulence convected past a sharp trailing edge. Measured effects of flow velocity and turbulence

intensity were compared with predictions from several theories. Also, tests were conducted in an anechoic chamber to determine surface pressure spectra and far field noise caused by a deflected airfoil scrubbed by a subsonic jet. This installation simulated both an under-the-wing and an upper-surface-blowing externally blown flap, depending on the deflection angle. Surface and far field spectra, and cross correlation coherence and delay time, were utilized to infer the major noise-producing mechanisms. Author

N75-17224* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

FIRE-RESISTANT AIRCRAFT MATERIALS DEVELOPMENT AND EVALUATION PROGRAM

c24

Richard W. Bricker and Robert N. Stuckey In Chamber of Commerce Proc. of the 1st 1974 Technol. Transfer Conf. 1974 p 445-491 refs

CSCL 11D

The overall objectives of this program are to provide a more fire-resistant commercial aircraft interior and to improve the fuselage insulation barrier between the cabin interior and an exterior fuel fire. Significant secondary objectives are to reduce the smoke and toxic gas production of the materials and to meet the end item use requirements pertaining to wearability, color fastness, and aesthetic appeal. It is shown that the fuselage insulation materials must meet stringent requirements pertaining to acoustic attenuation, low density, and water repellency. Author

N75-17226# Comptroller General of the United States. Washington, D.C.

PROBLEMS IN MANAGING THE DEVELOPMENT OF AIRCRAFT ENGINES

23 May 1974 36 p refs

(B-179166) Avail: NTIS HC \$3.75

The method traditionally followed by the military in developing and acquiring aircraft engines is evaluated in terms of its cost effectiveness. Evidence is presented that aircraft engines require further development of capability, performance and endurance beyond that needed to pass the model qualification test. The budgeting and financing of the component improvement program is detailed. Revisions of the presently used methods are proposed. N.E.R.

N75-17262# Lecce Univ. (Italy). Ist. di Fisica.

UPPER LIMIT FOR CH₄ PRODUCTION FROM COMET KOHOOTEK BY HIGH RESOLUTION TILTING-FILTER PHOTOMETRY AT 3.3 MICRONS

C. B. Cosmovici, S. Drapatz (Max-Planck-Inst. fuer Extraterrestrische Phys., Garching, West Ger.), K. W. Michel (Max-Planck-Inst. fuer Extraterrestrische Phys., Garching, West Ger.), A. E. Roche (Lockheed Palo Alto Res. Lab., Palo Alto, Calif.), and W. C. Wells (Lockheed Palo Alto Res. Lab., Palo Alto, Calif.) May 1974 24 p refs Submitted for publication

(LFC-UL-1) Avail: NTIS HC \$3.25

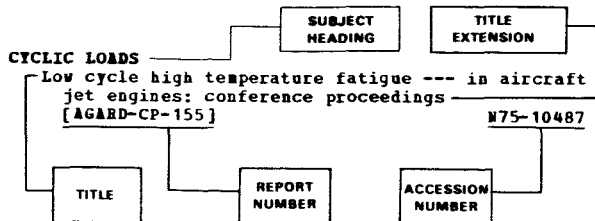
A Fabry-Perot tilting filter photometer, interfaced with a Dahl-Kirkham telescope, was designed for measuring methane concentration and its rotational temperature by isolating several lines in the ν_3 bands of the comet Kohoutek infrared spectrum. This assembly was flown on board a Convair 990 research aircraft. No measurable signals of methane emission were found; however, the upper limit for methane production, several orders of magnitude less than originally predicted for a first close approach of Kohoutek to the sun, could be calculated from the detection limit. ESRO

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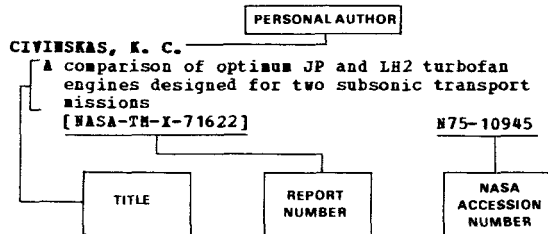
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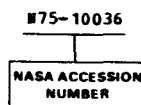
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Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the /AA accession numbers appearing first. The accession number denotes the number by which the citation is identified in either the /AA or STAR section.

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| AF PROJ. 1431 | N75-15624 | F44620-72-C-0088 | N75-15616 |
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